HISTORY OF THE FLORIDA ENTOMOLOGICAL SOCIETY [1]

A. N. Tissot [2], L. A. Hetrick [3], and Andrew J. Rogers [4]

Eleven men interested in entomology and related subjects met in Science Hall on the campus of the University of Florida, the afternoon of January 5, 1916. The group gathered for the expressed purpose of organizing an entomological society and they proceeded in a businesslike manner. The name Florida Entomological Society must have seemed so appropriate for the new organization that it was adopted without consideration of any other name. J. R. Watson, who was so intimately associated with the Society until his death in 1946, was selected as temporary chairman, and E. W. Berger as temporary secretary. A committee of three was appointed to draw up a constitution which was adopted at the first regular meeting on January 17, 1916. At that meeting the first permanent officers of the Society were elected. They were: President, J. R. Watson; Vice-President, Wilmon Newell; Secretary-Treasurer, R. N. Wilson; and Member of the Executive Committee, H. S. Davis.

The records and proceedings of the Society are not clear on the matter of charter members, but apparently all persons who affiliated with the Society during the first five meetings in 1916 were considered as charter members. These included E. W. Berger, T. N. Bradford, K. E. Bragdon, H. S. Davis, H. L. Dozier, J. C. Goodwin, Fritz Hatcher, S. P. Harn, A. C. Mason, Wilmon Newell, F. M. O'Byrne, W. E. Pennington, Frank Stirling, T. Van Hyning, Shirley B. Walker, J. R. Watson, and R. N. Wilson.

The Florida Entomological Society has the distinction of being the first entomological society organized in the South and it is among the twelve oldest in the United States. Notices of its establishment appeared in the February 4, 1916, issue of *Science*, the February number of *Journal of Economic Entomology* and in the March, 1916, number of *Entomological News*. Each of these reports named the officers of the new society and the item in *Science* gave the titles of papers read at the first meeting. *Entomological News* wished the Society "a long and useful life."

Few scientific organizations have enjoyed the rapid growth achieved by the Florida Entomological Society. During the first year its membership quadrupled and by the end of 1917 the Society had 100 active members and 20 associate members. However, as so often happens with individuals and organizations, the period of healthy growth and active interest enjoyed by the Society during its formative years, at times gave way to apathy and loss of interest, as well as a reduction in members.

In the beginning, monthly meetings were held except during summer, when many of the members were away on vacation. Occasionally special meetings were called when distinguished entomologists such as Doctors Herbert Osborn, H. T. Fernald, O. A. Johannsen, W. S. Blatchley, and others visited the University of Florida campus. Sometimes the Society held

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joint sessions with other organizations, such as Florida Academy of Sciences and the Horticultural Seminar, when these met in Gainesville. In spite of the increasing membership, attendance at the monthly meetings remained about the same. Minutes of the meetings show that eight to twelve persons usually were present and for the most part these faithful few were the men who founded the Society. In the early nineteen-twenties, meetings became less regular and attendance poorer. This condition persisted until the mid-thirties, and in some years only one meeting was held. The financial condition of the Society suffered similar deterioration and it seemed doubtful that the organization could long survive.

A handful of staunch members, led by Professor J. R. Watson, kept the Society alive through these years of adversity. There are no published reports, and no minutes can be found, so it seems fairly certain that no business meeting was held in 1934 and it may be assumed that the officers of the previous year continued to serve. On May 24, 1935, a meeting was held, at which time the following officers were elected: President, W. L. Thompson; Vice-President, A. N. Tissot; Secretary, G. B. Merrill; Editor, J. R. Watson; and Business Manager, H. E. Bratley. At that meeting, on the recommendation of Professor Watson, the Society voted to hold annual meetings in lieu of the nominal monthly ones. The first in the series of annual meetings was held in Gainesville, October 30-31, 1936. Fifteen papers were presented at this meeting. There was a good attendance of members and guests and everyone enthusiastically acclaimed the plan to hold annual meetings rather than more frequent ones. Since 1936, meetings have been held yearly, except in 1945 when the meeting was canceled because of war-imposed, travel restrictions which would have held attendance to a very small number. In that year election of officers was held by mail ballot. In spite of the success of the 1936 Annual Meeting it was felt that further stimulation of interest was desirable so President R. L. Miller called a general meeting to be held in Gainesville, March 20, 1937, for the purpose of reorganizing and revitalizing the Society. At that time the group authorized the president to appoint a committee to prepare a new constitution and by-laws. J. W. Wilson, J. R. Watson, E. W. Berger, and J. T. Creighton were named to serve on this committee. The committee functioned promptly and well and at the 1937 Annual Meeting a proposed constitution and by-laws was presented by Dr. Creighton. The Society voted to accept this as a temporary working guide for one year. It was formally adopted at the 1939 Annual Meeting. This document, patterned after the constitution of the American Association of Economic Entomologists, gave the Society excellent guidance for its various activities, and specifically defined and provided for all normal functions of the organization. With only minor amendments the constitution has served the Society well through the intervening years.

The 1948 meeting was historically significant for two reasons. Each of the previous annual meetings had been designated by the year in which it was held. The 1948 meeting was known as the Thirty-first Annual Meeting, as it occurred thirty-one years after the founding of the Society. Subsequent meetings have been designated in ordinal sequence. This meeting was held at the San Juan Hotel in Orlando and it thus had the distinction of being the first meeting of the Society away from Gainesville. All phases of entomology had flourished and expanded in recent years and entomologists

were stationed in all sections of Florida. It thus was thought desirable to hold subsequent meetings in other parts of the State where suitable facilities and accommodations were available. Meetings were held at Tampa, 1949; Sanford, 1950; Winter Haven, 1951; Fort Pierce, 1952; Miami, 1953; Bradenton, 1954; Jacksonville, 1955; Tallahassee, 1956; Orlando, 1957; Tampa, 1958; and Miami, 1959.

Other factors undoubtedly entered the picture and it would be difficult to determine how much of the improvement could be attributed to the change in meeting plans; but the Society certainly has flourished since the system of annual meetings was inaugurated. In 1938, one year after the annual meetings were started, the Society had a membership of 79. Nine members lived in other states and the District of Columbia and the others were residents of Florida. Since then the scope of influence of the Society has widened greatly and now reaches to other parts of the world. It was reported at the 1959 annual meeting that the Society then had 289 members. Reference to the membership roll shows that 61 of the members lived outside the borders of Florida. Fifty of these were residents of other states, the District of Columbia, the Canal Zone, and Puerto Rico. At least one member of the Society lived in each of the following foreign lands: Canada, Costa Rica, Cuba, El Salvador, Italy, Japan, Mexico, and Nicaragua.

The astonishing early growth of the Society attests to the enthusiasm and interest of its founders. These men were keenly aware of the great importance of entomology and they were imbued with a missionary spirit which made them want to share their interest and knowledge with others. The purposes and ideals of the group were clearly stated as follows: "The aim of the Society is to stimulate an active interest in entomology on the part of Floridians. There is at the present time a marked dearth of amateur entomologists in the State. Membership in the Society is by no means limited to professional entomologists. Anyone who is interested in, or desires information on 'bugs' may became a member."

A spirit of willing cooperation is good for any organization and the Florida Entomological Society showed this trait, early in its history. Within months of its founding the Society considered the possibility of affiliating with the Florida Academy of Sciences. Negotiations were finally completed and in April, 1917, the Society became Section B of the Academy. It developed later that the constitution of the Academy required members of sections to be full members of the Academy and pay membership dues. This caused dissatisfaction among the entomologists and in April, 1918, the Society voted to sever its relations with the Academy.

Late in 1917 the Lee County Entomological Society presented a petition requesting permission to become a Branch of the Florida Entomological Society. The constitution of the Society did not provide for branches but it was amended and on January 15, 1918, the Lee County Society was accepted as a Branch of the Florida Entomological Society. At the time of application, the new Branch had twelve members. Five of these men were members of the parent society and their President was a charter member. Professor Watson visited the Lee County group and later wrote "A more wide-awake and earnest group of men would be hard to find. Men who will spend the whole of a summer day in Florida in a grove looking for citrus canker and then spend the evening studying entomology will be heard from. May the branch grow as has the parent." Unfortunately these fond hopes

were not realized and there is no further information on the Branch. A vegetable insect laboratory at Fort Myers was closed early in 1920 and this may have contributed to the early death of the Lee County Branch of the Society.

The Society cooperated with various other organizations in activities of scientific or public interest. Thus, in February, 1923, a resolution addressed to the Gainesville City Board of Health expressed the hope that "a thoroughly effective anti-mosquito campaign be staged in Gainesville and vicinity." Members of the Society residing in Gainesville pledged themselves to aid in an educational campaign and they offered to help in locating breeding places of mosquitoes or in directing control measures. A few months later it was reported that a mosquito control program had been set up in Gainesville, that the Board of Health had appropriated $500 for the work and that destruction or oiling of mosquito breeding places was in progress.

At the 1938 Annual Meeting, the Society authorized the Executive Committee to petition the American Association of Economic Entomologists for affiliate membership in that organization for the Florida Entomological Society. A petition signed by the President and Secretary was sent to the Secretary of A.A.E.E. in December, 1938. The petition was published in the Proceedings of the Fifty-first Annual Meeting of A.A.E.E., in the February, 1939, number of the *Journal of Economic Entomology*, with the following comment: "This petition, presented at the first Executive Committee meeting, was accepted, referred to the Association and confirmed at the final business session." The Florida Entomological Society thus became the first state society to affiliate with the national group of professional entomologists.

The Florida Entomological Society and the Newell Entomological Society, a student organization at the University of Florida, were hosts to the Cotton States Branch of the American Association of Economic Entomologists at the Branch meeting in Tampa, February 21-23, 1939. Once again, in December, 1949, the Florida Entomological Society served as host to visiting entomologists, when it met in Tampa in conjunction with the annual meetings of the Entomological Society of America and the American Association of Economic Entomologists. In addition to helping with the general arrangements for the meetings, the Society sponsored and conducted a two day field trip to the Everglades National Park for about a dozen visitors from the North.

The 1940 annual meeting was of particular significance as it marked the completion of a quarter century of useful service by the Society. On the evening of December 13, the Silver Anniversary Dinner of the Florida Entomological Society was held in honor of Professor J. R. Watson, charter member, first president, and Editor of the *Florida Entomologist* since the first issue appeared in June, 1917. Three other charter members, Dr. Wilmon Newell, Dr. E. W. Berger and Mr. J. C. Goodwin also were present at the dinner. They and several others gave acclaim to the wonderful service rendered by Professor Watson who unquestionably had done more for the Society than any other member.

Nearly forty years after the Lee County Branch of the Society was admitted, another group of entomologists expressed a desire to unite with the Florida Entomological Society. At the 39th Annual Meeting in Tallahassee

the Sub-Tropical Entomologists of Florida presented a petition requesting affiliation as a Branch of the Society. This group came into being in September, 1955, when Dr. John E. Porter, U.S. Public Health Service Entomologist, called together 13 persons interested in entomology, in an informal meeting at the University of Miami to discuss the desirability of forming an Entomological Society in the Miami area. After three more informal monthly meetings with an average attendance of 22 persons, the group voted to organize as the Sub-Tropical Entomologists of Florida. Meetings are held monthly and varied phases of entomology are studied and discussed. In addition, the group plans and develops special projects designed to stimulate interest in entomology and to "distribute widely knowledge pertaining to insects." The petition of the group was favorably accepted, and at the 40th annual meeting in Orlando on September 13, 1957, the Sub-Tropical Branch in Miami was formally received into the Florida Entomological Society. This affiliation should prove highly profitable for the parent society and the Branch as well as to the science of Entomology in general.

An account of the service activities of the Florida Entomological Society would be far from complete without some mention of the "Entomology in Action" program. This began with the preparation, by Lewis M. Wright, of a short talk illustrated with a series of 35 mm. color slides depicting entomology in action. Mr. Wright gave the talk at the 1957 annual meeting and stated that it and the slides were available to members of the Society who wished to give them before service clubs, 4-H clubs, and other groups. At that same meeting an Entomology in Action committee was named. From Mr. Wright's slides and other sources the committee assembled thirty 8 x 10 color prints of pictures to "catch the eye of the student and possibly cause him to consider entomology as a career." These prints were framed and mounted on five plywood panels which form an exhibit 11 feet long. The display was designed especially for use with 4-H groups but it has been exhibited on many other occasions.

Several entomological events and numerous insect related activities in Florida have greatly influenced the Florida Entomological Society through the years. Many of the early members were State Plant Board personnel engaged in the citrus canker eradication program. Plant Commissioner Wilmon Newell led in this campaign and he also directed both State and Federal forces in the successful eradication of the Mediterranean fruit fly in 1929-30. The Plant Board played a major role in the eradication of the second "Med fly" invasion in 1956-57 and participated in the programs involving the citrus blackfly, the white-fringed beetles, the imported fire ant, the screw-worm fly, and other pests.

Much entomological work is done in various divisions of the University of Florida and other educational institutions in the State. The Department of Entomology in the College of Agriculture has trained many of the entomologists in Florida, and its staff and students established the Newell Entomological Society. This organization joined the Florida Entomological Society in various activities and functions. Agricultural Experiment Station entomologists in Gainesville and at the branch stations and field laboratories have made worthwhile contributions to the agricultural economy of Florida. Mention should also be made of the work of Extension Service

entomologists and of naturalists in the Biology Departments of universities and colleges in Florida.

The State Board of Health was created in 1889 after an epidemic of yellow fever in 1888. The scope of its activities gradually broadened and in recent years this Board has had a phenomenal growth. In 1946 the Bureau of Malaria Control was established and this has now become the Division of Entomology, State Health Board. The Division established a Research Center at Vero Beach which works on all phases of mosquito and sand fly problems and their control. This modern laboratory is unique in many respects and it has few equals anywhere in the world.

Federal entomologists stationed in various parts of Florida have participated in many entomological activities. Special mention should be made of the Orlando Laboratory of the Division of Insects Affecting Man and Animals, which did such valuable work during World War II and is still continuing its activities. Also in Orlando, the Fruit Insects Laboratory is doing research on pests of citrus and other subtropical fruits. Federal entomologists also have taken part in control or eradication campaigns on several introduced insect pests.

The phenomenal growth of agriculture in Florida brought a corresponding increase in insect pest problems. This in turn produced a great need for all sorts of pest control chemicals and application machinery, as well as the services of workers to make, sell, and apply these products. There has been a tremendous expansion of the insecticide industry in Florida, particularly in the past decade. Florida residents have demanded more and more help with pest control problems in and about their homes. This has brought a rapid increase in the number of commercial pest control agencies in the State.

Entomologists associated with the various State, Federal, and commercial organizations have formed the backbone of the Florida Entomological Society and from their ranks have come its officers and committee members. Many of these men later went to other assignments and the influence of the Society thus has been carried to many parts of the world.

The original constitution of the Florida Entomological Society made provision for certain functions and activities including publication of a periodical. Taking advantage of this privilege, the Society, at the meeting of April 23, 1917, voted "that a committee of three with the President as chairman be formed to make arrangements for a publication to be issued by this Society and to report at the next monthly meeting." The President, Dr. E. W. Berger, appointed Professor J. R. Watson and Mr. H. S. Davis to serve with him on the committee. At the next meeting on May 21, 1917, the committee made its report and the Society voted to "arrange for the publication of a periodical at intervals to be decided by the editorial staff entitled *The Florida Buggist*, with the subtitle, *The Official Organ of the Florida Entomological Society*. J. R. Watson was elected Editor, E. W. Berger, Associate Editor, and K. E. Bragdon, Business Manager. It also was provided that in so far as possible all papers presented before the Society and all the Brief and Timely notes given at the meetings be published either complete or in condensed form in *The Florida Buggist*. The Society authorized the Business Manager "to solicit advertisements of the proper kind to assist in financing publication; accepting advertising matter

only from those companies who deal in articles concerning insect control, the study of entomology, etc., and whose reliability can be guaranteed."

Volume 1, Number 1, of the *Florida Buggist*, designated "Summer Number", was dated June 21, 1917. This was a twelve-page issue and its size set the pattern for the next three numbers. Later issues varied somewhat in size but for the next several years they generally contained 16 or 20 pages. The original plan to publish one volume of four numbers per year has been followed through the years with only slight deviation. In 1918 and again in 1924 and 1947 two numbers were combined in one issue. During the difficult middle thirties publication became somewhat irregular, a situation common to most entomological journals, but it never was discontinued. Pages in the first two volumes were numbered consecutively through both volumes but thereafter each volume began a new page series. Volume 42, published in 1959, contained 194 pages. The largest volume to date, Vol. 37, published in 1954, contained 220 pages. Number 2 of this volume was a commemorative issue for the Centennial of Professional Entomology and it contained 72 pages.

The name *The Florida Buggist* was used for only three volumes of the periodical. With Number 1 of Volume 4 the name was changed to *The Florida Entomologist* and thereby hangs a tale of one of the few serious controversies among members of the Florida Entomological Society. The first evidence of dissatisfaction with the name of the periodical is an item in the minutes of the meeting of November 19, 1917, which reads: "The matter of a suitable heading for '*The Florida Buggist*' was discussed and it was voted that this be left to the discretion of the editors." Apparently nothing was done about this until the meeting of February 23, 1920. The minutes for that meeting show that President G. B. Merrill, Vice President C. M. Hunt, Secretary J. H. Montgomery and eight other members were present and they also include this item: "Under the head of new business Dr. Montgomery presented for consideration of the Society a proposition to change the name of the official organ of the Society. There was considerable discussion which was participated in by practically all members present, and after considering various suggestions decision was finally arrived at that the name of the publication be changed from '*The Florida Buggist*' to '*The Florida Entomologist*', this upon motion of Mr. O'Byrne seconded by Montgomery." Obviously the decision to change the name was not unanimous for on the editorial page of *The Florida Buggist*, Volume 3, No. 4, March, 1920, we find the following: "In accordance with a vote of the Society at its February meeting, *The Florida Buggist* will, with the new volume, become *The Florida Entomologist.*

"Yes, and the Business Manager regrets that this change of name was made without at least a month's previous notice, and without getting the vote of the non-resident members. It is the writer's belief that changes of name of a publication should not be hastily made; especially when it is considered that *The Buggist* has completed three years of an honorable record, being successful far beyond the anticipation of its originators. A few people, somewhere in the United States, have been critical of the name *Buggist*, and so the movers, for a change, Buggists who visited the Entomological meetings at St. Louis in December, rushed home and *ology* it must be with 'all other ologies whatsoever.' Verily, like a rush to cover of chickens from a shadow.

"If those who are similarly minded will voice their sentiments by writing at once to the Secretary, there is still time for reconsideration. If the name must be changed, the writer would suggest *The Florida Insectist*—a name that is new and different and not stale. E. W. B."

Eighteen non-resident members did write as suggested. All favored the name *Florida Entomologist*, so it was retained and used without further question. The four issues of Volume 4 had "(Formerly *The Florida Buggist*)" under the name *The Florida Entomologist* but thereafter even this reminder of the old name ceased to appear.

Many persons and organizations have helped in numerous ways to make *The Florida Entomologist* a successful and respected publication. Some have made outstanding contributions that deserve special recognition. Foremost acclaim must go to Professor J. R. Watson who was editor of the first issue in 1917 and who continued to serve in this capacity until his death in 1946. He did much more than edit manuscripts and send them to the publisher. On several occasions, particularly during the 1930's, Professor Watson came to the rescue of the Society and advanced money from his personal funds to make publication of the *Florida Entomologist* possible. The Pepper Printing Company of Gainesville has printed every issue of *The Florida Entomologist*. During periods of austerity this company extended credit much beyond reasonable demands and allowed accumulated bills to be paid gradually. Several concerns have helped the Society through the years by taking advertising space in *The Florida Entomologist* and two of these merit special acknowledgment. The Pepper Printing Company has carried a quarter or half page ad in every issue of the Journal. Tobacco By-Products and Chemical Corporation placed a full page advertisement of their products in the April, 1923, number of *The Florida Entomologist* and this was continued without breaks until March, 1955, when the company was sold to another concern. Without these benefactors the publication very likely would have gone into oblivion as several entomological journals have done.

With the death of Professor Watson, Associate Editor G. B. Merrill assumed the responsibility of publication of *The Florida Entomologist* for the remainder of 1946. He was succeeded by Dr. H. K. Wallace who served as editor for three years. The present editor, Dr. Lewis Berner, assumed the position with the first issue of 1950. Under his guidance the Journal has grown in size and increased in quality and prestige. The publication now is received on subscription by 55 libraries in the United States and 29 in foreign countries. In addition there are both domestic and foreign exchanges.

On January 21, 1921, The Florida Entomological Society conferred Honorary Membership upon Doctor Herbert Osborn, Professor Emeritus from Ohio State University, who was loved by all his former students and respected by entomologists everywhere. In following this custom the Society gave like recognition to other distinguished entomologists. These are:

Dr. W. M. Barrows, 1927
Dr. H. T. Fernald, 1927
Dr. L. O. Howard, 1928
Dr. Edith M. Patch, 1940
Dr. Charles T. Brues, 1948
Dr. James G. Needham, 1948
Mr. W. W. Yothers, 1952
Dr. O. A. Johannsen, 1952
Mr. K. E. Bragdon, 1954
Mr. A. C. Brown, 1954
Dr. W. V. King, 1954
Mr. G. B. Merrill, 1957

At the 1959 annual meeting it was announced that the newly instituted Certificates of Honorary Membership had been presented to the five living honorary members, K. E. Bragdon, A. C. Brown, W. V. King, G. B. Merrill and W. W. Yothers.

List of Past Presidents

Florida Entomological Society

1916 J. R. Watson
1917 E. W. Berger
1919 F. M. O'Byrne
1920 G. B. Merrill
1921 J. R. Watson
1922 Frank Stirling
1923 G. B. Merrill
1924 G. B. Merrill
1925 J. S. Rogers
1926 John Gray
1927 W. W. Yothers
1928 E. D. Ball
1929 E. F. Grossman
1930 R. D. Dickey
1931 C. F. Byers
1932 A. N. Tissot
1933 Paul Calhoun
1934 [5]
1935 W. L. Thompson
1936 W. L. Thompson
1937 R. L. Miller
1938 W. V. King
1939 J. H. Montgomery
1940 Herbert Spencer
1942 K. E. Bragdon
1943 T. H. Hubbell
1944 A. H. Madden
1945 A. C. Brown
1946 H. K. Wallace
1947 M. R. Osburn
1948 E. G. Kelsheimer
1949 M. C. Van Horn
1950 J. A. Mulrennan
1951 W. G. Bruce
1952 J. W. Wilson
1953 J. T. Griffiths
1954 D. O. Wolfenbarger
1955 F. Gray Butcher
1956 Herman S. Mayeux
1957 Milledge Murphey, Jr.
1958 Irwin H. Gilbert
1959 Wm. P. Hunter
1960 A. J. Rogers

We would like to name and recognize the many members of the Society who through the years have served it so well, by holding office, working on committees or rendering other necessary services. All too often their only reward was the inner satisfaction that comes from doing a job well. Lack of space does not permit such acknowledgement so, on behalf of the Society, we say to all these deserving persons a grateful "Thank You."

References

Science N.S. 43: No. 1101 p. 167. 1916.

Journal of Economic Entomology. 9: p. 250. 1916.

Entomological News. 27: p. 133. 1916.

Florida Buggist-Florida Entomologist. Vols. 1-42, 1917-1959. (Especially Vol. 40, pp 39-44, 1957, "A Review of the History of the Florida Entomological Society at its Fortieth Anniversary", by J. W. Wilson).

Minutes of Meetings and other unpublished records of The Florida Entomological Society.

[5] There is no evidence that an election was held and it is presumed that the officers carried over from 1933.

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NEW INSECTICIDES FOR THE CONTROL OF SALT-MARSH MOSQUITOES

A. N. Davis and J. B. Gahan
Entomology Research Division, Agric. Res. Serv., U.S.D.A.

As malathion was found to be an effective adulticide for salt-marsh mosquitoes, *Aedes taeniorhynchus* (Wied.) and *A. sollicitans* (Wlk.), when dispersed in aerial sprays (Gahan *et al.*, 1956) and ground-generated aerosols (Rogers *et al.*, 1957), it has become the principal insecticide used against these species in Florida. Although there have been no reports that it is less effective now than when first used, efforts are being continued to find other materials that will be even more effective. This paper reports the results that have been obtained during 1959-1960 against these species of salt-marsh mosquitoes with 2 new materials that appear to be superior to malathion, are not highly toxic to warm-blooded animals, and are expected to be commercially available in this country. Included are the results of tests run to evaluate their effectiveness in the laboratory as larvicides and adulticides, and in the field as adulticides.

Bayer 29493 (*O,O*-dimethyl *O*-(4-methylthio-*m*-tolyl) phosphorothioate, marketed in some countries as Baytex) is a brown liquid that has a faint odor. It is soluble in most organic solvents and insoluble in water. Dibrom (1,2-dibromo-2,2-dichloroethyl dimethyl phosphate) is a liquid that is slightly soluble in aliphatic solvents, highly soluble in aromatic solvents, and insoluble in water. The latter compound is stable under anhydrous conditions, but is almost completely hydrolyzed in water within 48 hours.

Laboratory Tests Against Larvae: A series of laboratory tests was conducted to evaluate the effectiveness of these 2 compounds as larvicides. They were compared with malathion and DDT against fourth-instar larvae of a laboratory reared colony of *Aedes taeniorhynchus*. The chemicals were added to 250 ml. of distilled water in glass beakers as solutions in a small amount of acetone. Twenty-five larvae were introduced into each beaker and the mortalities were recorded after 24 hours. Each compound was tested at 5 to 7 concentrations selected to produce a range of mortalities. Two beakers were used for each concentration. The results of these tests are shown in Table 1.

TABLE 1. Percent Kill of Salt-Marsh Mosquito Larvae After 24-Hour Exposures in Water Treated with Selected Larvicides.

Larvicide	Concentration (p.p.m.)					
	1	0.1	0.05	0.025	0.01	0.005
Bayer 29493	—	—	—	100	99	48
Malathion	—	92	49	3	0	0
Dibrom	100	84	27	5	0	—
DDT	54	54	32	14	11	10

Bayer 29493 was at least 10 times as effective as any of the other materials. Malathion was superior to Dibrom and DDT, but the differences between malathion and Dibrom were slight. Previous field work with malathion and DDT has shown they are not outstanding larvicides against salt-marsh mosquitoes at the present time. Resistance to DDT has become so extensive that the use of this chemical has been curtailed greatly, and studies by Davis and Gahan (1957) have shown that malathion must be used at dosages above 0.1 pound per acre to produce good control. Although no field larvicide tests have been conducted with Bayer 29493, it appears to be effective enough to provide satisfactory control at low application rates.

Laboratory Tests Against Adults.—Bayer 29493 and Dibrom were evaluated as contact sprays against adult mosquitoes from the laboratory colony of *Aedes taeniorhynchus*. The insects were exposed to a range of concentrations of each insecticide in a wind tunnel. The wind tunnel consisted of a cylindrical tube 4 inches in diameter through which a column of air was moved at 4 m.p.h. by a suction fan. The mosquitoes in a cylindrical screen cage were placed in the center of the tube. One-fourth milliliter of insecticide solution was atomized at a pressure of 1 p.s.i. into the mouth of the tunnel and the mosquitoes were exposed momentarily to the insecticide as it was drawn through the cage. After treatment the insects were transferred to untreated screen holding cages and furnished a solution of honey in water. The mortalities were recorded after 24 hours. The results of these and similar tests with malathion and DDT appear in Table 2.

TABLE 2.—Percent Mortality of Salt-Marsh Mosquitoes 24 Hours after Treatment with Various Insecticides in Wind-Tunnel Tests.

	Concentration (percent)							
Insecticide	0.5	0.25	0.1	0.05	0.025	0.01	0.005	0.0025
Bayer 29493	—	—	—	—	100	93	65	23
Dibrom	—	—	—	—	100	78	17	2
Malathion	—	—	—	100	100	47	3	—
DDT	91	82	46	23	—	—	—	—

Bayer 29493 was slightly more effective than Dibrom, and about twice as effective as malathion. DDT was about 1/10 as effective as malathion at the LC-50 and 1/28 as effective at the LC-90.

Field Tests Against Adults.—Bayer 29493, Dibrom, and malathion were applied to 50-acre plots in citrus groves that were naturally infested with adults of *Aedes taeniorhynchus*. Fuel oil solutions of the insecticides at various concentrations were sprayed from a Stearman airplane flying 100-foot swaths at a speed of 85 miles an hour and an altitude of 50 to 75 feet. All sprays were applied at the rate of 3 quarts per acre, early in the morning under favorable meteorological conditions. Each concentration was tested 3 times.

Control was determined by making pre- and post-treatment counts of the mosquitoes that landed on the front and back of two observers who stood side by side facing in opposite directions at 10 different locations in each of the treated areas. From these counts the number per man per minute was calculated. Post-treatment counts were made after 6 hours. Other observations were made after 24 hours, but by that time mosquitoes had infiltrated from unsprayed areas and the control was below its maximum. The results of these tests are given in Table 3.

TABLE 3.—Effectiveness of 3 Compounds as Aerial Sprays Against Natural Populations of Salt-Marsh Mosquitoes.

Insecticide	(pound/acre)	Pretreatment counts	Percent control after 6 hours
Bayer 29493	0.05	66	99
	.025	89	87
	.01	30	61
Dibrom	.05	55	100
	.025	25	99
	.012	53	56
Malathion	.1	103	97
	.05	26	90
	.025	112	41

Bayer 29493 and Dibrom were highly effective, producing 99% reductions at 0.025-0.05 pound per acre. Bayer 29493 also gave 87% control at 0.025 pound per acre. Malathion produced 90% control at 0.05 pound and 97% control at 0.1 pound. Neither malathion nor Dibrom was highly effective at 0.025 pound per acre.

Discussion. Bayer 29493 and Dibrom appear to be safe to use around inhabited areas. According to information furnished by their manufacturers they are less toxic than DDT to warm-blooded animals, but more toxic than malathion. The acute oral LD-50 reported for rats is 310 mg./kg. for Bayer 29493, and 430 mg./kg. for Dibrom. The acute dermal LD-50 of Dibrom on rats is 1,100 mg./kg.

No information is available on the toxicity of Dibrom to fish. The results of this study indicate the chemical is not an outstanding larvicide, so its effects on fish probably will be of no importance in determining whether this insecticide will be used. However, Bayer 29493 shows promise of being a very useful larvicide and its activity against fish is important. Jung (1959) studied the effect of this compound on *Lebistes reticulatus* and found it produced 100% mortality in 48 hours at a concentration of 10 p.p.m. but no mortality in 48 hours at 1 p.p.m. The latter concentration is 100 times that required to kill 99% of the larvae of *Aedes taeniorhynchus*, so it should be possible to select dosages that are effective against these mosquitoes but not dangerous to fish.

If Bayer 29493 and Dibrom can be marketed at a price that will make them competitive with malathion, both can be very useful in adult control

operations against salt-marsh mosquitoes. Bayer 29493 also could prove to be a highly effective larvicide.

Summary

Bayer 29493 and Dibrom were more effective than malathion or DDT in laboratory and field tests against adults of *Aedes taeniorhynchus* (Wied.). In field tests both compounds produced 99% reduction within 6 hours at a dosage of 0.05 pound per acre, and Bayer 29493 gave 87% control at 0.025 pound. Bayer 29493 was at least 10 times as effective as any of the other materials in laboratory larvicide tests.

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PRELIMINARY STUDIES OF INSECT AND MOLD INFESTATIONS OF ANTICOAGULANT RODENTICIDE BAITS

ANDREW J. BROOKS AND HAROLD GEORGE SCOTT [1]

The traditional rodenticides (arsenic, strychnine, thallium, phosphorus, and zinc phosphide) have always presented a hazard to humans and domestic animals. In addition, rodents receiving sublethal doses of these poisons develop bait shyness. With the development of warfarin in 1947, a less obvious, more effective rodenticide program became possible. This rodenticide, first of the anticoagulants, is relatively safe for use around man, and rodents never seem to develop bait shyness toward it. Other anticoagulants have been developed, and now pival, fumarin, tomorin, PMP, diphacin, as well as warfarin, are widely used.

In order to be killed by an anticoagulant, the rodent must eat a little every day for several days. One dose, accidental or purposeful, will kill neither rodent nor man. Since death is produced by internal hemorrhage, a human ingesting multiple doses can be treated effectively with vitamin K and, if indicated, whole blood transfusion by the nearest physician even when that physician does not know the cause of the hemorrhagic condition. This makes the anticoagulants remarkably safe.

For some reason, the rodents do not seem to connect their weakened state with the anticoagulant poisoned food and no bait shyness develops. The rodents continue to feed at the anticoagulant bait stations until they die.

However, certain difficulties are encountered in the use of anticoagulant rodenticides. Most have to do with the length of time baits must remain exposed to bring about effective control. For Norway rats (*Rattus norvegicus*), 14 days of exposure are recommended even though the first rats begin to die about the fifth day. For house mice (*Mus musculus*), up to 30 days of exposure are recommended with the first mice dying about the fifth day. In addition, preventive baiting, which requires constant exposure, is being practiced. In preventive baiting, permanent anticoagulant rodenticide stations are set up and maintained continuously to prevent reinfestation of stores, warehouses, etc., previously made rodent free.

THE INSECT AND MOLD PROBLEM

Materials used in anticoagulant rodenticide baits to attract rodents are also attractive to other forms of life. Exposed baits may soon become infested with beetles, silverfish, ants, and other stored-food insects. If baits become wet, or if the humidity is high, mold soon forms. Rodents do not seem to be disturbed by insects in their food, but they tend to refuse moldy baits. The insects, while they do not discourage acceptance by the rodents, can destroy large quantities of bait material, particularly in permanent preventive stations. In addition, valuable stored foods and other items may become infested with insects introduced by anticoagulant rodenticide

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TABLE 1.—Arrangement of Test Jars at Beginning of Experiment.

Jar No.	Cornmeal 120 g.	Sugar 6 g.	Warfarin 0.06 g.	Pivalyn 0.06 g.	Fumarin 0.06 g.	Malathion 0.012 g.	Confused Flour Beetles 10 each	Relative Humidity
1	X							under 50%
2	X						X	under 50%
3	X					X	X	under 50%
4	X					X		under 50%
5	X	X	X					under 50%
6	X	X	X				X	under 50%
7	X	X	X			X	X	under 50%
8	X	X	X			X		under 50%
9	X		X					under 50%
10	X		X				X	under 50%
11	X		X			X	X	under 50%
12	X		X			X		under 50%
13	X	X		X				
14	X	X		X			X	under 50%
15	X	X		X		X	X	under 50%
16	X	X		X		X		under 50%
17	X			X				under 50%
18	X			X			X	under 50%
19	X			X		X	X	under 50%
20	X			X		X		under 50%

TABLE 1—(continued)

Jar No.	Cornmeal 120 g.	Sugar 6 g.	Warfarin 0.06 g.	Pivalyn 0.06 g.	Fumarin 0.06 g.	Malathion 0.012 g.	Confused Flour Beetles 10 each	Relative Humidity
21	X	X			X			under 50%
22	X	X			X		X	under 50%
23	X	X			X	X	X	under 50%
24	X	X			X	X		under 50%
25	X				X			under 50%
26	X				X		X	under 50%
27	X				X	X	X	under 50%
28	X				X	X		under 50%
29	X	X						under 50%
30	X	X					X	under 50%
31	X	X				X	X	under 50%
32	X	X				X		under 50%
33	X	X	X					95%
34	X	X		X				95%
35	X	X			X			95%
36	X	X						95%

baits, and many pest control operators have lost customers because they introduced insect infestations during rodent control operations. Also, bait materials are often stored for a long time in rodent control storerooms before use, and economic loss from these infestations can be considerable.

Exposed grain is rapidly contaminated by airborne spores. Also, fungus spores and insect infestations are usually already present in newly milled grain. The material may appear insect free, but it is probable that insect eggs are present, as widely-used modern milling processes neither remove nor destroy all insect eggs. In addition, many grain storage warehouses are heavily infested with insects, and freshly-cleaned grain becomes reinfested rapidly.

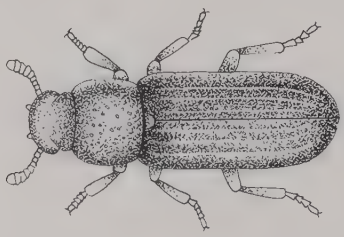

Figure 1. The confused flour beetle, *Tribolium confusum* DuVal.

The confused flour beetle, *Tribolium confusum* DuVal (figure 1) is the commonest pest of broken (milled or damaged) grain as well as the one causing the greatest economic loss. Females lay 400 to 500 eggs each during their adult life span of about 1 year with egg laying beginning within a few days after emergence of the adults. Distinguishing features of the different larval stages have not been worked out (Cotton, 1956, p. 40). At 71.5°F., the cycle from egg to adult requires about 93 days divided as follows: egg, 14 days; larva, 61 days; pupa, 18 days (Chapman and Baird, 1934). Type of broken grain involved causes variance in the length of the life cycle (Sweetman and Palmer, 1928).

It has been reported (Laudani et al., 1953; Saunders and Bay, 1958) that pival inhibits or prevents the development of flour beetles while warfarin has little if any detrimental effect.

Nature of the Study

A study was made by the authors of (1) the effects of warfarin, pivalyn (sodium pival), and fumarin on the development of the confused flour beetle in rodenticide baits; (2) the effects of these rodenticides on the spontaneous development of molds in baits; (3) the effect of 0.01% malathion on insect infestations in the baits; and (4) the effect of 5% sugar on the development of insect infestations in anticoagulant baits.

Procedures: Thirty-six jars were prepared as shown in Table 1. Ingredients were thoroughly mixed and 32 jars kept at room temperature and below 50% relative humidity (conditions similar to those at which anticoagulant baits might be stored). The other 4 jars were kept at room temperature, but at about 95% relative humidity in a specially devised high-

humidity chamber (Brooks and Scott, 1958). Figure 2 shows the experiment in progress.

Observations were made on (1) spontaneous development of molds, (2) survival of adult beetles in seeded jars, (3) rate of reproduction and larval development in seeded jars, and (4) spontaneous development of insects.

Results: Mold had not developed at the end of 123 days in the 32 jars kept at less than 50% relative humidity. Mold development in the 4 jars kept at 95% relative humidity is shown in Table 2. Only a thin layer of surface mold was visible in the pivalyn test jar after 123 days. Figure 3 shows the pivalyn jar and the control after 42 days.

TABLE 2.—Mold Development in Jars Kept at 95% Relative Humidity.

Jar	Musty Odor	Visible Mold	Mold Throughout Jar
33 (warfarin)	7th day	10th day	28th day
34 (pivalyn)	44th day	51st day	———
35 (fumarin)	7th day	10th day	28th day
36 (control)	7th day	10th day	28th day

Little mortality of adult beetles was observed in jars not containing 0.01% malathion. In the malathion jars, however, mortality was rapid and complete (Table 3).

TABLE 3.—Survival of Adult Beetles in Seeded Jars.

Jar No.	Number of Seeded Adult Beetles Surviving after 2 days	5 days	29 days	45 days
2	10	10	10	10
3m*	10	4	0	0
6	10	10	9	9
7m	10	4	0	0
10	10	10	10	10
11m	10	3	0	0
14	10	10	8	8
15m	10	5	0	0
18	10	10	9	9
19m	10	3	0	0
22	10	10	10	10
23m	10	4	0	0
26	10	10	10	10
27m	10	6	0	0
30	10	10	10	10
31m	10	3	0	0

* m—test jar contained 0.01% malathion.

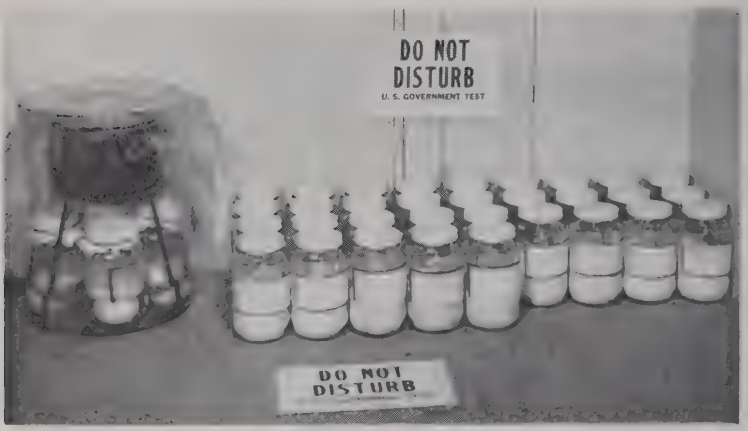

Figure 2. Experiment in progress. High humidity chamber with 4 jars at left.

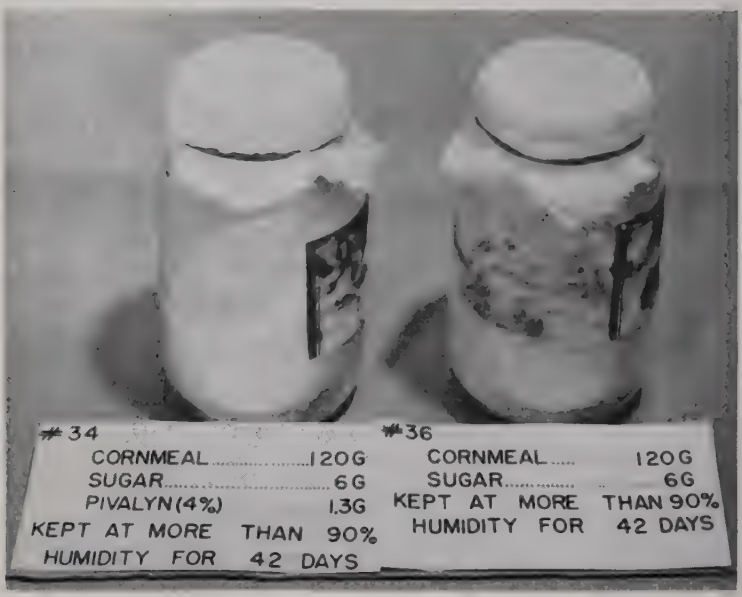

Figure 3. Comparison of mold growth in jars with and without pivalyn after 42 days.

TABLE 4.—Reproduction and Development of *Tribolium confusum* in Seeded Jars.

Jar No.	Contents of Test Jar	Developmental Stages Observed in Seeded Jars after				
		29 days	52 days	71 days	87 days	98 days
2	control w/o sugar	larvae	adults	adults	adults	adults
6	warfarin with sugar	larvae	pupae	pupae	adults	adults
10	warfarin w/o sugar	larvae	pupae	pupae	adults	adults
14	pivalyn with sugar	larvae	larvae	larvae	larvae	larvae*
18	pivalyn w/o sugar	———	larvae	larvae	larvae	larvae**
22	fumarin with sugar	larvae	larvae	pupae	adults	adults
26	fumarin w/o sugar	larvae	larvae	larvae	pupae	adults
30	control with sugar	larvae	pupae	adults	adults	adults

* One adult emerged on 98th day; all other beetles in early larval instars.
** Only early larval instar beetles present on 123rd day.

No larvae developed in the 8 seeded jars containing malathion. In the other seeded jars, speed of reproduction and development varied as shown in Table 4. Adults appeared first in the control jars, then in the warfarin jars, and then in the fumarin jars. One adult emerged from the jar containing 5% pivalyn and sugar, but the other beetles in this jar were still in the early larval instars. At the conclusion of the experiment (123 days) only early larval beetles were present in the pivalyn jar not containing sugar. It appeared that third generation adults emerged in the control and warfarin jars before the conclusion of the experiment.

At the end of 123 days, none of the unseeded jars showed any signs of insect infestation.

Discussion

This experiment indicates: (1) that mold will develop in warfarin and fumarin baits left under humid conditions for the 15 to 30 days recommended for domestic rodent control, but that no mold problem will develop with pivalyn unless baits are exposed for longer than 7 weeks; (2) that adult *Tribolium confusum* feeding on anticoagulant rodenticide baits will *not* be killed; (3) that development of *T. confusum* infestations will occur freely in warfarin baits, will be retarded in fumarin baits, and will occur only rarely in pivalyn baits; (4) that 0.01% malathion will keep anticoagulant baits free of *T. confusum,* and (5) that addition of sugar to fumarin and pivalyn baits decreases their insecticidal effect on *T. confusum.*

From the practical standpoint this indicates that neither warfarin nor fumarin baits should be used in humid areas without the addition of a mold retardant chemical. Pivalyn could be used under these circumstances, but if permanent preventive baiting is used, fresh baits will be required every 7 weeks. The chance of introducing a beetle infestation with warfarin baits is good, but such will probably not occur with fumarin or pivalyn baits. Maintenance of insect-free baits under storage conditions will be easier with fumarin and pivalyn than with warfarin. Addition of 0.01% malathion to baits essentially eliminates the insect problem. Malathion is toxic to man (U. S. Public Health Service, 1953), but the anticoagulants are also poisonous and baits should be protected from human consumption whether or not they contain malathion. Finally, sugar should not ordinarily be added to fumarin and pivalyn baits as it partially negates their insecticidal qualities.

Summary

Experiments were conducted to determine (1) the effect of anticoagulant poisons on the development of mold and confused flour beetles (*Tribolium confusum*) in rodenticide baits; and (2) the effect of 0.01% malathion and 5% sugar on *T. confusum* in these baits.

The results indicate that: (1) mold will develop in warfarin and fumarin baits left under humid conditions for the 15 to 30 days recommended for domestic rodent control, but that no mold will develop with pivalyn unless baits are exposed for longer than 7 weeks; (2) adult *T. confusum* feeding on anticoagulant rodenticide baits will not be killed; (3) development of *T. confusum* will occur freely in warfarin baits, but will be greatly retarded in fumarin baits, and will occur only rarely in pivalyn baits; (4) 0.01% malathion will keep baits free of *T. confusum;* and (5) use of sugar

in baits containing fumarin and pivalyn will lessen their insecticidal activity.

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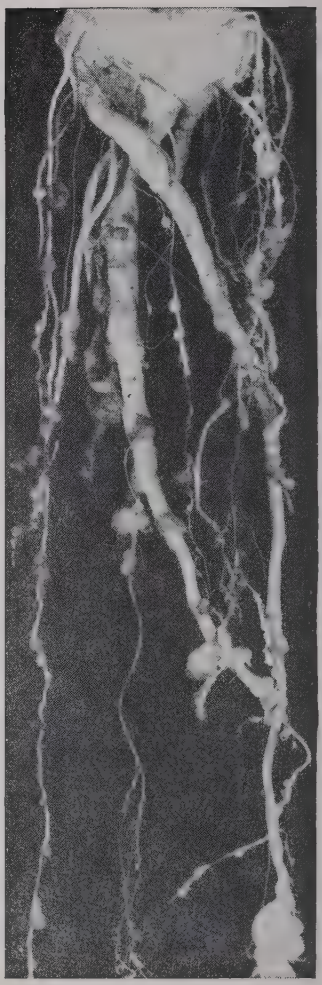

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CONTROL OF SOME INSECTS ATTACKING CELERY IN THE EVERGLADES [1, 2, 3]

EMMETT D HARRIS, JR.
Everglades Experiment Station, University of Florida, Belle Glade

The green peach aphid, *Myzus persicae* (Sulz.), and the serpentine leaf miner, *Liriomyza pusilla* (Meig.), have been found more frequently than other insect pests on celery for several years. The green celeryworm, *Platysenta sutor* (Gn.), and other caterpillars are more populous in the late spring or early summer. Wilson and Hayslip (1951) have discussed the insects attacking celery and their control.

During cooler periods of the 1958-59 growing season many Everglades celery growers complained about failure to get adequate control of the green peach aphid. Investigations were conducted primarily to evaluate several insecticides for green peach aphid control but with the secondary purpose of evaluating these materials for effectiveness against other celery pests. An experiment was conducted to determine if a mixture of toxaphene and parathion would be more effective than either chemical used alone. Harris (1959) and Baranowski (1959) discussed reasons for evaluating mixtures of insecticides.

Wolfenbarger (1960) reported that there had been frequent instances of an insecticide being initially effective against the green peach aphid on potatoes but with a subsequent decrease in effectiveness after a few years of use. He reported that parathion remained effective for about 10 years, that toxaphene was effective in many seasons, and that Thiodan was currently effective against this insect. Wolfenbarger (1958) reported that toxaphene and certain other chlorinated hydrocarbon insecticides initially had been effective against the serpentine leaf miner on potatoes but had become ineffective after one to three seasons. He reported that there was evidence parathion did not retain its original effectiveness after 10 years of use, but that Diazinon was effective.

Harris (1959) reported that the systemics demeton and phosphamidon, were more effective than non-systemic insecticides tested for green peach aphid and serpentine leaf miner control on potatoes. Trithion was the most effective non-systemic insecticide against the green peach aphid.

Baranowski (1959) reported that the addition of toxaphene increased the effectiveness of parathion and Diazinon wettable powder sprays against the green peach aphid on tomatoes. Admixture with DDT decreased the effectiveness of both parathion and Diazinon. Harris (1959) reported that toxaphene-parathion mixtures in emulsion gave better control of the green peach aphid and the serpentine leaf miner on potatoes than either parathion or toxaphene alone.

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[1] Florida Agricultural Experiment Station Journal Series No. 1114.

[2] The author thanks Mr. A. B. Jimmerson and Mr. C. E. Seiler for aid in conducting the experiments, Mr. Edward King, Jr., for preparing the graphs and Mr. Ronald Jones for photography.

[3] Aided by grants from Shell Chemical Company, Hercules Powder Company, and California Spray-Chemical Corporation.

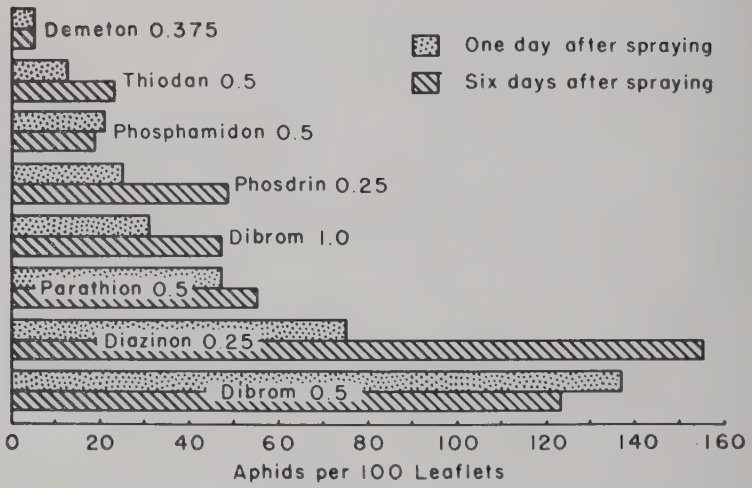

Figure 1. Green peach aphid populations after the final application in Experiment I.

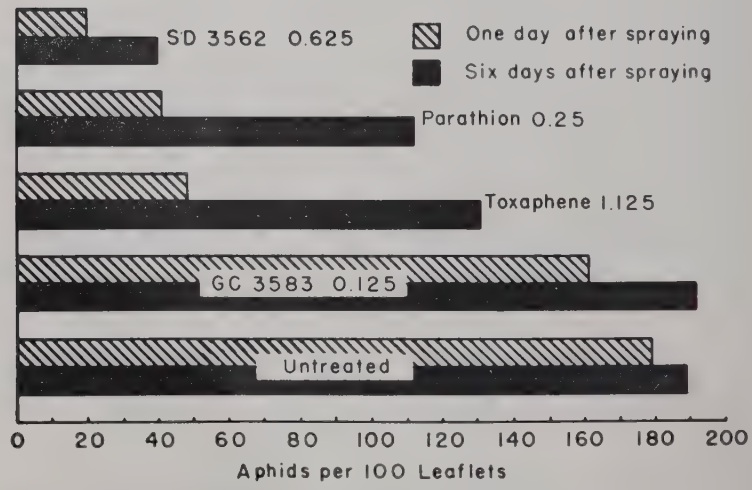

Figure 2. Average green peach aphid populations 1 day after 3 applications and 6 days after 4 applications in Experiment II.

Procedure

In each experiment, Utah 52-70 celery plants were planted 6 inches apart in rows that were 36 inches apart. A standard-size plot of 4 rows 25 feet in length was used throughout. Blocks were separated by 20 foot alleys running across the rows. Treatments were replicated 5 times in each experiment although 3 types of experimental design were represented: the randomized complete block, the Latin square, and the Greco-Latin square.

A self-propelled, 2-row, small-plot sprayer (Harrison *et al.*, 1959) equipped with Spraying Systems Disc Type Teejet Hollow Cone nozzles (D2-25 in Experiments I and V and D4-23 in Experiments II, III, and IV.) was used. Application rates were 50 gallons per acre with 2 overhead nozzles per row and 100 gallons per acre when a nozzle was added on each side of the row. Spraying pressure was 250 psi in Experiments I-IV and 100 psi in Experiment V. Sprayer speed was 2.4 mph in Experiments I-IV and 1.8 mph in Experiment V. The pounds of actual toxicant per 100 gallons of spray are shown for each insecticide in each figure.

Serpentine leaf miner control was evaluated by counting total mines and active mines on leaflets from the tops of plants. An active mine was considered to be one that contained a clear area indicating the destruction of the mesophyll layer in the leaflets. A non-active mine was one which consisted of a small brown spiral; it appeared that the insect had been destroyed early in its development.

Comparison of Insecticides

In each experiment, plots were separated by unplanted buffer rows along which the sprayer traveled. All insecticides were applied in emulsions.

Experiment I. The object of this experiment was to compare demeton, Thiodan, phosphamidon, Phosdrin, parathion, Diazinon, and 2 rates of Dibrom. Celery was planted on February 17, 1959. Treatments and the untreated check were arranged in a randomized complete block design. Sprays were applied on March 2, 16, and 29, April 17 and 27, and May 11. The first two applications were made with 2 overhead nozzles per row; a single nozzle was added on each side of each row for the remaining 4 sprays.

The green peach aphid was the only insect that was numerous enough to evaluate the insecticides and then only after the final spray. Three leaflets from 10 plants in each of the 2 middle rows of the plots were examined.

When compared as classes, the systemic insecticides, phosphamidon and demeton, were significantly more effective than the non-systemic 1 day after application. Six days following the final application, this difference was highly significant. Thiodan, the non-systemic insecticide resulting in the lowest aphid population, was not significantly better than parathion. The population in the untreated check, which was not included in the analysis of variance, was 126 and 214 aphids per 100 leaflets at 1 and 6 days after application, respectively.

Experiment II. Parathion, toxaphene, SD 3562 [4], GC 3583 [5] and an un-

[4] 3-(dimethoxyphosphinyloxy)-N, N-dimethylcrotonamide (Shell Development Company).

[5] Diethyl-1-(2,5-dichlorophenyl)-2, 2-dichloro-vinyl phosphate (General Chemical Division, Allied Chemical Company).

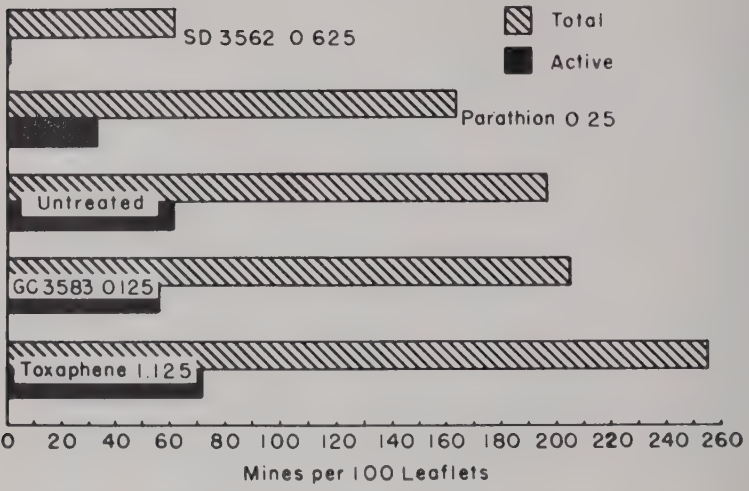

Figure 3. Serpentine leaf miner populations 5 days after the final application in Experiment II.

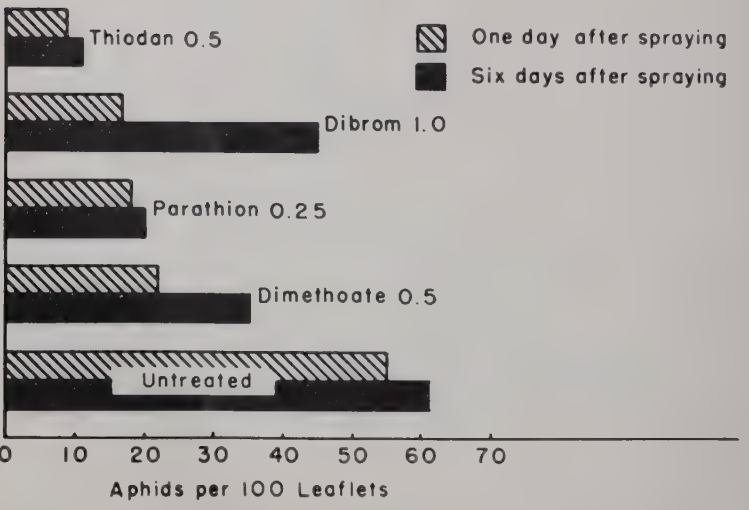

Figure 4. Green peach aphid populations after the first application in Experiment III.

treated check were compared in an experiment of Latin square design on celery that was planted on October 15, 1959. Sprays were applied on November 17 and December 1, 8, and 15.

The number of aphids on 1 top leaflet from each of 10 plants in each of the 2 middle plot rows was taken at intervals of 1 and 6 days after each application with the exception of the one-day count following the first application. The averages of the 3 one-day counts and the 4 six-day counts are shown in Figure 2.

Among the counts made 1 day after applications, SD 3562, parathion, and toxaphene were not significantly different from each other but each resulted in an aphid population that was significantly lower than GC 3583 or the untreated check. For the 6-day counts, SD 3562 was the only treatment that significantly reduced the green peach aphid population below that in the untreated check.

A single leaflet was taken from the top of 5 plants in each row 5 days after the final application and examined to evaluate the efficacy of the insecticides against the serpentine leaf miner. SD 3562 resulted in significantly fewer total mines per 100 leaflets than parathion, toxaphene, GC 3583, or the untreated check (Figure 3) and significantly fewer active mines than GC 3583, taxaphene, or the untreated check.

Experiment III. Thiodan, Dibrom, parathion, and Dimethoate were compared on the same celery following Experiment II. Any bias resulting from the preceding experiment was minimized by using a Greco-Latin square design so that each treatment in Experiment III followed each treatment in Experiment II once. Sprays were applied through 4 nozzles per row on December 29, January 5, and 12.

The only insect appearing in this experiment in sufficient numbers to compare treatments was the green peach aphid. A single leaflet from the top of 10 plants in each of the 2 middle rows was examined on each observation date, but because of low populations after the second and third spray, data from only the first spray were used to make comparisons. One day after application, insecticides were not significantly different and each resulted in an aphid population that was significantly less than that in the untreated check but on the sixth day no insecticide treatment was significantly different from the untreated check (Figure 4).

Experiment IV. Demeton, parathion, Trithion, and Methyl Trithion were compared on celery that was planted on October 15, 1959.

Sprays were applied on December 29, January 5, and January 12 using 4 nozzles per row. Demeton was not applied on January 5 because it was felt that its systemic nature would cause it to remain effective longer than the other insecticides. Counts following the final spray were not used in treatment comparisons because of extremely low populations. Results of the first 2 sprays were combined for the purpose of making treatment comparisons (Figure 5). One day after application, Trithion had significantly fewer aphids than Methyl Trithion. Parathion, demeton, and Trithion were not significantly different. Demeton resulted in a significantly lower population than the average of the other insecticides. The average population among treated plots was significantly less than that in the untreated checks. Six days after applications there were no significant differences among treatments or between treatments and the untreated check.

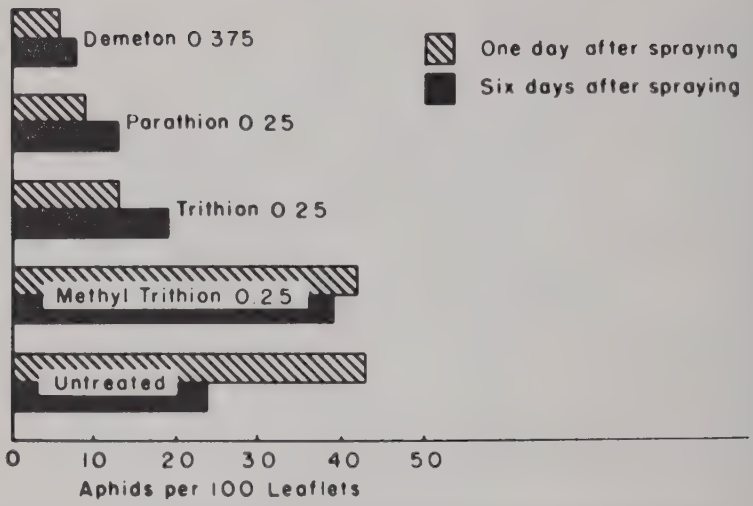

Figure 5. Average green peach aphid populations after 2 applications in Experiment IV.

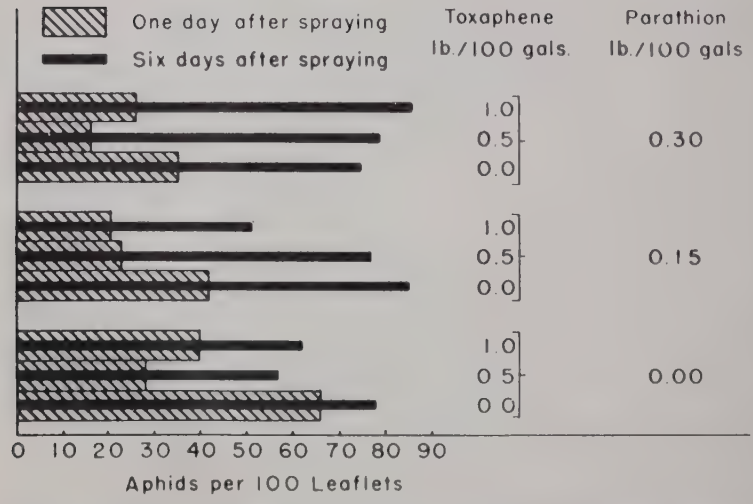

Figure 6. Average green peach aphid populations 1 day after 4 applications and 6 days after 3 applications in the experiment on parathion-toxaphene mixtures for insect control on celery.

Parathion-Toxaphene Combinations

Experiment V. The purpose of this experiment was to determine if a mixture of parathion and toxaphene would differ from parathion or toxaphene alone in effectiveness against celery insects.

Celery was planted on March 14, 1960. Plots were separated by 2 rows planted to sweet corn and okra that were not treated with insecticide in an effort to maintain a heavier insect population in the experiment.

Toxaphene 65 percent WP and parathion 15 percent WP were used alone and in combination at dosages shown in Figures 6-8. Sprays were applied on April 20, May 4, 11, 18, and 25, and June 1 through 4 nozzles per row.

The number of aphids on single leaflets from the tops of 5 plants in each row was recorded 1 day after the first, second, third, and fifth sprays and 6 days after the first, second, and fourth sprays. Results shown in Fig. 6 are the averages for all 1-day and 6-day examinations. One day after applications, toxaphene highly significantly reduced the green peach aphid population when used alone and when mixed with 0.15 pound of parathion per 100 gallons (Figure 6). Toxaphene significantly increased the control obtained with 0.30 pound of parathion per 100 gallons. Differences between 0.15 pound and 0.30 pound of parathion and between 0.5 pound and 1.0 pound of toxaphene were not significant. Parathion highly significantly reduced the green peach aphid population when averaged over all levels of toxaphene (including no toxaphene). For the average of the 6-day counts there were no significant differences among treatments.

One day after the final spray, a single leaflet from the top of each of 10 plants in every row was examined for leaf mines. The total number of mines differed little from the number of active mines, thus only the numbers of active mines are presented (Figure 7). Parathion significantly decreased the number of active mines but 0.15 and 0.30 pound were not significantly different. Toxaphene did not significantly affect the leaf miner population. No treatment provided satisfactory control.

The green celeryworm was present in large numbers at the time of the last application. Parathion was significantly more effective than toxaphene in reducing the number of plants that were contaminated with fecal pellets (Figure 8). Parathion, alone and at each toxaphene dosage, significantly reduced fecal contamination. Toxaphene did not significantly influence the effectiveness of parathion in mixtures. There was no significant difference between 0.15 and 0.30 pound of parathion or between 0.5 and 1.0 pound of toxaphene.

Summary and Conclusions

Although it was not significantly different from all of the other treatments with which it was compared, demeton resulted in the lowest aphid populations in both of the experiments in which it was tested. Thiodan resulted in a lower population of aphids than other non-systemic insecticides in the 2 experiments in which it was evaluated, but it failed to be significantly different from them. SD 3562 resulted in an aphid population that was less (not significant) than parathion and toxaphene. Toxaphene significantly increased the efficacy of parathion against the green peach aphid in insecticide mixtures. Differences between 0.5 and 1.0 pound of toxaphene and between 0.15 and 0.30 pound of parathion were not significant.

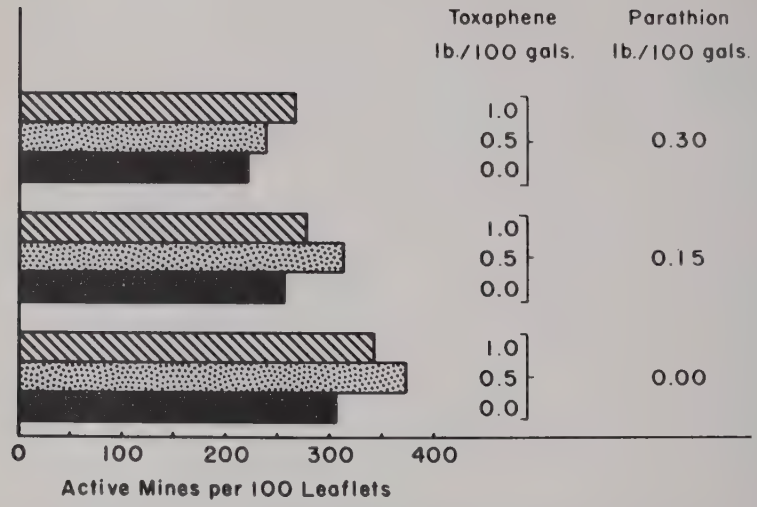

Figure 7. Serpentine leaf miner populations 1 day after the final application in the experiment on parathion-toxaphene mixtures for insect control on celery.

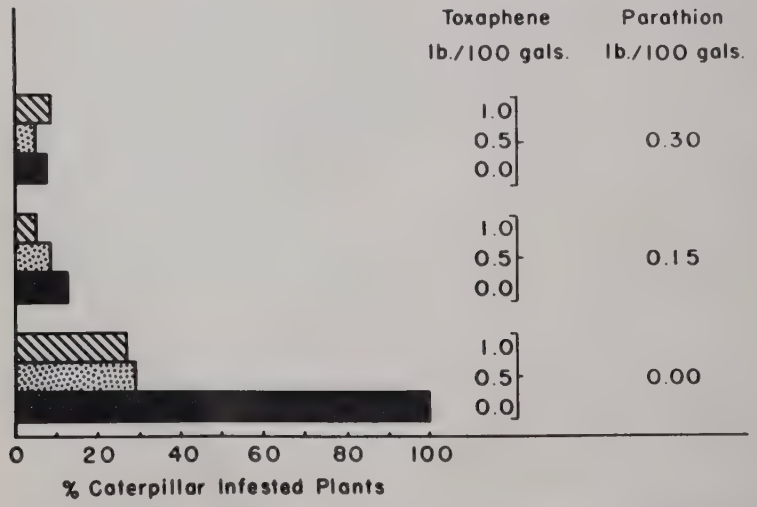

Figure 8. Fecal contamination by the green celeryworm 1 day after the final application in the experiment on parathion-toxaphene mixtures for insect control on celery.

SD 3562 was significantly more effective than parathion or toxaphene for serpentine leaf miner control. Toxaphene did not significantly affect the leaf miner population alone or when combined with parathion. Parathion significantly decreased the leaf miner population but there was not a significant difference between 0.15 and 0.30 pound per acre, and the level of control was not satisfactory.

Parathion was significantly more effective than toxaphene in controlling the green celeryworm. Toxaphene significantly reduced the population but did not significantly affect the efficacy of parathion.

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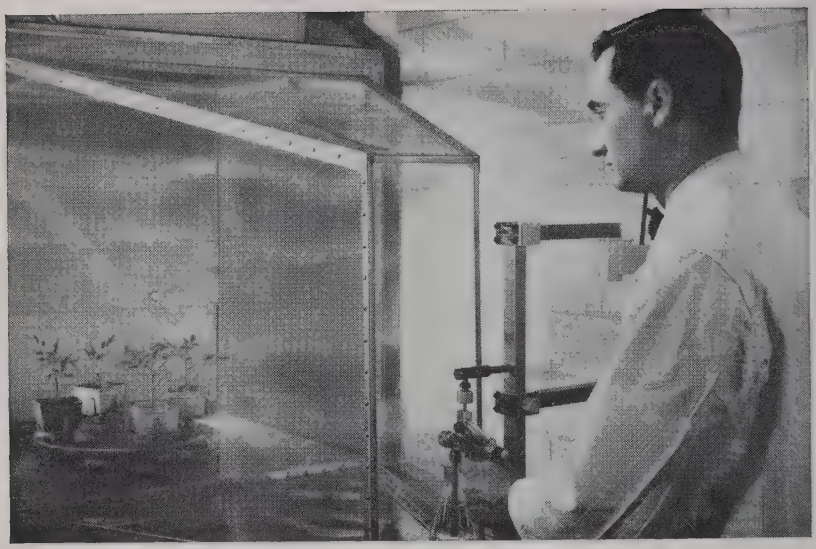

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THREE NEW MILLIPEDS OF THE GENUS *CLEIDOGONA* (CLEIDOGONIDAE: CHORDEUMIDA) FROM THE SOUTHERN STATES

Nell B. Causey
Fayetteville, Arkansas

The three species of *Cleidogona* described here bring the number from the United States to 22. There probably are others in the Southeastern States. Thorough collection, especially during the fall and winter months in the South, and revision of the genus are needed.

The southernmost record for the genus in Florida is Lake County.

Acknowledgments and Deposition of Types

Mr. W. E. Tarpley and Dr. Howard V. Weems, Jr., generously contributed the specimens that are mentioned in this paper.

The holotypes of the forms described here will be deposited in the American Museum of Natural History. A male paratype of *Cleidogona alata* will be deposited in the United States National Museum.

The holotype of *Cleidogona moderata* Causey was previously stated to be in the American Museum of Natural History (Causey, 1957); the correct deposition is the California Academy of Sciences, Golden Gate Park, San Francisco, California.

Genus *Cleidogona* Cook and Collins

Cleidogona, Chamberlin and Hoffman, 1958, U. S. Nat. Mus., Bull. 212, p. 89, *cum synon.*

The anterior gonopods of *Cleidogona* are relatively simple. The sternum is a weak rodlike piece; laterad, where it is expanded, it articulates freely with a small, triangular sclerite and the coxal skeleton. There is no cheirite. The coxal skeleton is entirely free from its homologue, but the two approach or touch each other in the midline. Laterad the coxa extends distad as a triangularly shaped piece that bears a few stiff setae. The seminal canal opens at the apex of the most conspicuous part of the anterior gonopod, the ventral or anterior branch. The two less conspicuous dorsal or posterior branches (the "bifid plate" of the genus *Pseudotremia*) have been incorrectly referred to as the posterior gonopods by recent authors.

The posterior gonopods, or ninth legs, are composed of 5 segments. The first is an elongated coxoprefemur, the second is an elongated and thickened femur, the third and fourth, which are short and subequal, are the postfemur and the tibia, and the last segment, the tarsus, is about equal to the preceding two. There is a tarsal claw.

The legs anterior to the gonopods show little modification; occasionally the coxae of the seventh pair bear a small protuberance on the caudal surface. The coxae of the tenth and eleventh legs have conspicuous gland openings and usually from 1 to 3 small ridges, lobes, or protuberances; the second segments sometimes bear a rounded protuberance on the mesial surface; and the third segments usually protrude on the lateral surface. The sternal peg between the twelfth legs is the largest in the family.

Cleidogona saripa, new species
Figures 1 and 2

DIAGNOSIS: A small species closely related to *C. hadena*, from which it is distinguished by details of the apical region of the ventral branch of the anterior gonopods.

TYPE LOCALITY: Savannah River Plant, Aiken Co., South Carolina, 1 ♂, Dec. 21, 1957, W. A. Tarpley.

RANGE: Known only from the type locality.

DESCRIPTION OF THE MALE HOLOTYPE: Length about 16 mm., greatest width 1.5 mm. Body brown above, shading to white below the segmental setate. Metazonites darker than prozonites. Metazonites of typical body segments with six small, light colored oval spots on which the segmental setae are set; a larger light colored oval area is between the outer two spots and confluent with them; prozonites with a large light colored spot contiguous with the large spot on the metazonites. Antennae and top of head brown. Eyes black, the ocelli in series of 1, 7, 6, 5, 4, 1. Legs white at base, shading to light brown distad.

Legpairs 1 and 2 shorter, as usual. Legpairs 3 and 4 slightly shorter. First 4 segments of legpairs 3 through 7 slightly swollen. Mesodistal margin of segments 3 of legpairs 5, 6, and 7 produced in a short, acute angle. Caudal surface of coxae of legpair 7 with a small, rounded protuberance; much of the mesial surface of the coxae is finely granular. Coxae of legpairs 10 and 11 with the usual cylindrical lobe through which the coxal gland opens. Coxae of legpair 10 with 2 small lobes on the distal margin, one laterad and the other mesiad; the dorsal surface of the mesial lobe is granular. Caudal surface of coxae of legpair 11 with a small triangular lobe and a longitudinal ridge. Sternal peg between legpair 12 rectangular, the anterioventral angle with a minute knot at the apex.

The anterior gonopods are as shown in figures 1 and 2. The ventral branch is slightly bowed toward its homologue and perhaps touches it at the apex. The bifid condition of the apical region of the anterior gonopod is best seen from the lateral view; the ventral apical lobe is flattened and broadly rounded at the apex; the dorsal apical lobe is longer than the ventral lobe, its apex is narrowly acute, and it is membranous and fringed along the mesial margin. The seminal canal opens on the fringed margin of the dorsal apical lobe.

The dorsal branches of the anterior gonopods are sharply bent; the apical region is bifid and larger than in *C. hadena* but not as large as in *C. carolina* Causey 1957.

The posterior gonopods, or ninth legs, are without any distinctive characters, as shown in the figure of *C. wrayi* Causey, 1957. The mesial

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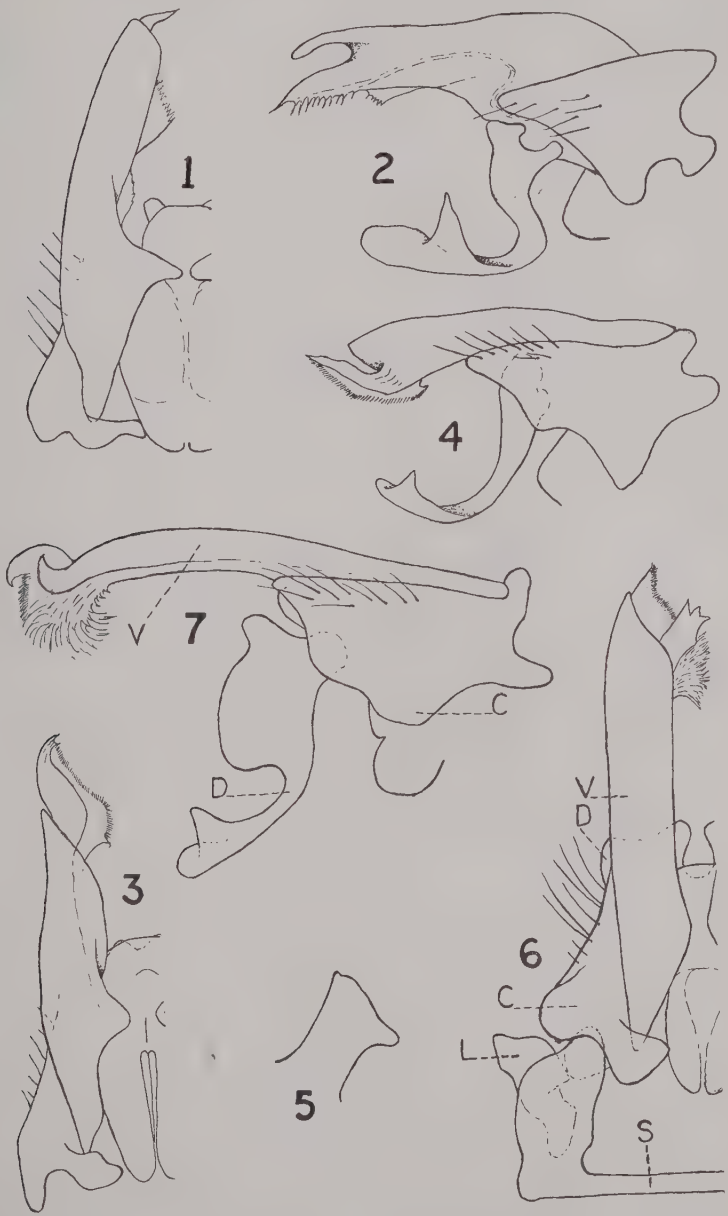
Cleidogona saripa, n. sp. Fig. 1. Left anterior gonopod, ventral view. Fig. 2. Left anterior gonopod, lateral view.

Cleidogona hadena, n. sp. Fig. 3. Left anterior gonopod, ventral view. Fig. 4. Left anterior gonopod, lateral view.

Cleidogona alata, n. sp. Fig. 5. Sternal peg between twelfth legs. Fig. 6. Left anterior gonopod, ventral view. Fig. 7. Left anterior gonopod, lateral view. C, coxa. D, dorsal branch. L, lateral sclerite. V, ventral branch. S, sternum.


1
2
4
V
7
C
D
3
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V
D
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C
L
S

surface of the coxoprefemur is divided into two unequal parts, of which the distal part is rounded and about twice the length of the proximal part, which is squarish but in life is probably rounded. The ratio of the length to the thickness of the femur is about 3/1.

The female is unknown.

Cleidogona hadena, new species

Figures 3 and 4

DIAGNOSIS: Nearest *C. saripa*, from which it is distinguished by details of the apical region of the ventral branch of the anterior gonopods.

TYPE LOCALITY: Juniper Springs, Marion Co., Florida, 1 ♂, Oct. 30, 1959, R. E. Woodruff.

RANGE: Known only from the type locality.

DESCRIPTION OF THE MALE HOLOTYPE: Length 17 mm., greatest width 1.6 mm. Body brown above, shading abruptly to white below the segmental setae. Metazonites and prozonites about the same color. Arrangement of light colored oval spots as in *C. saripa*. Antennae and top of head brown. Eyes black, the ocelli arranged in series of 1, 7, 6, 5, 4, 2.

Legpairs 1 through 7 as in *C. saripa*. Coxal gland lobes of legpairs 10 and 11 longer than they are wide. Legpair 10 with a rounded, warty protuberance on the mesodistal surface of the coxae, a warty protuberance on the mesial surface of segment 2, and a protuberance without warts on the distolateral surface of the coxae. Caudal surface of the coxae of legpair 11 with a small triangular lobe and a longitudinal ridge. Sternal peg between legpair 12 with a minute knot at the anterioventral angle and the margin above it rounded.

The anterior gonopods are as shown in figures 3 and 4. In situ the ventral branches are well separated, subparallel, and the mesial setose pieces are nearly contiguous in the midline; the apical region is divided into a shorter, stouter, simple ventral piece that is broadly angular at the apex and a longer membranous piece that is finely setose along its mesial margin. The opening of the seminal canal is at the acute apex of the setose piece.

The dorsal branches of the anterior gonopods are arched. Their apical region is small and bifid (figure 4).

The posterior gonopods, or ninth legs, are without any distinctive characters. Details are approximately as described for *C. saripa*.

The female is unknown.

Cleidogona alata, new species

Figures 5-7

DIAGNOSIS: In the *saripa* series; distinguished by the large lateral lobes at the base of the dorsal branches of the anterior gonopods.

TYPE LOCALITY: 1 mile south of Ila, Madison Co., Georgia, pine-hardwood forest, 2 ♂, Jan. 17, 1953, E. J. Kuenzler.

RANGE: Known only from the type locality.

DESCRIPTION OF THE MALE HOLOTYPE: Length about 17.5 mm., greatest width 1.8 mm. After 7 years in alcohol, the color of the dorsum is light brown, shading to cream color below the segmental setae. Metazonites

darker than the prozonites. Arrangement of the light colored spots as in *C. saripa.* Antennae and top of head brown. Eyes black, the ocelli arranged in series of 1, 7, 6, 5, 3, 2, 1.

Legpairs 1 through 7 as in *C. saripa.* Coxae of legpairs 10 and 11 with thick, cylindrical lobes approximately twice as long as broad through which the coxal glands open. Legpair 10 with lateral and mesial protuberances on the distal margin of the coxal segments and on the mesial surface of segments 2; the mesial lobes are granular. Legpair 11 with the coxal segments enlarged distad and with a shallow transverse furrow across the caudal surface. Anterioventral angle of the sternal peg between legpair 12 with a rounded lobe (figure 5).

The anterior gonopods are as shown in figures 6 and 7. In situ the ventral branches are subparallel and contiguous only along the mesial margin of the fringed membrane. The apical region bears 2 membranous pieces; the smaller one is subapical and mesiad; the other one is much larger, the position is mesodorsal, and its margin is partly fringed and partly setose.

The dorsal branches of the anterior gonopods are much less curved than in related species. At the apex they are bifid and relatively small. Laterad and near the base each dorsal branch bears a large bilobed piece that with its homologue forms a basinlike structure.

The posterior gonopods are without any distinctive characters. Details are approximately as described for *C. saripa.*

The male paratype has the distal region of the ventral branches of the anterior gonopods damaged. In all other important characters it corresponds to the holotype.

The female is unknown.

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THE GENUS *BREVIPALPUS* IN MEXICO, PART II (ACARINA: TENUIPALPIDAE)[1]

DONALD DE LEON
Erwin, Tennessee

Part I of this paper dealt with the species group having 6 pairs of dorsolateral hysterosomal setae, palpus with 2 setae and a sensory rod at distal end, and tarsus II of the female with 1 sensory rod; Part II deals with the other species groups known to occur in Mexico and includes a key to the species of all the groups.

All measurements are in microns and body length includes the rostrum.

The following 12 species belong to the species group having 6 pairs of dorsolateral hysterosomals, palpus with 2 setae and a sensory rod at distal end, tarsus II of the female with 2 sensory rods, and the posterior metapodosomals very much longer than the anterior pair:

Brevipalpus proboscidius, n. sp.
(Figure 25)

Brevipalpus proboscidius is distinct in having the rostrum extending about to the distal end of tibia I. The male and nymph are unknown.

FEMALE: Body bright scarlet; length 340, width 154. Markings of dorsum and shapes of dorsal setae as shown in figure 25. Metapodosoma medially practically smooth; ventral plate with areolae somewhat wider than long; genital plate with areolae much wider than long.

Holotype: Female, Tuxtla Gutierrez, Chiapas, January 15, 1957, (D. De Leon), on *Liabum glabrum* var. *hypoleucum*. *Paratypes*:3 females, collection data same as for holotype.

Brevipalpus rostratus, n. sp.
(Figures 26A and 26B)

Brevipalpus rostratus differs from others in this species group by having the rostrum reaching about to the middle of genu I. The male is unknown.

FEMALE: Body bright scarlet; length 307-325, width 167. Markings of dorsum and shapes of dorsal setae as shown in figure 26A. Venter smooth medially anterior of posterior metapodosomals, with small rounded areolae between these setae and anterior part of frame of ventral plate; ventral plate with small rounded areolae; genital plate with areolae much wider than long. Tarsal claws with large hooks.

NYMPH: Shapes of dorsal setae as shown in figure 26B.

Holotype: Female, San Cristobal, Chiapas, January 22, 1957, (D. De Leon), on *Myrica mexicana*. *Paratypes*: 3 females, 6 nymphs, collection data same as for holotype.

[1] This work has been aided by a grant from the Sigma Xi-RESA Research Fund.

Brevipalpus encinarius, n. sp.
(Figures 27A and 27B)

Brevipalpus encinarius is distinguished from other members of this species group by having propodosomal 1 large and the hysterosoma smooth medially.

FEMALE: Body bright red; length 266, width 154. Markings of dorsum and shapes of dorsal setae as shown in figure 27A. Metapodosoma practically smooth medially; ventral and genital plates with areolae wider than long. Tarsal claws with large hooks.

MALE: Resembles female, but dorsum covered with small rounded areolae.

NYMPH: Shapes of dorsal setae as shown in figure 27B.

Holotype: Female, east of Morelia, Mich. (km post 292, Route 15), June 5, 1957, (D. De Leon), on *Quercus* sp. (near *castanea*). *Paratypes*: 1 male, 1 nymph, collection data same as for holotype; 3 females, Quiroga, Mich., March 11, 1957, from same host species. A single female was taken from oak at Ocozocoatla, Chiapas, January 1957.

Brevipalpus cordiae, n. sp.
(Figure 28)

Brevipalpus cordiae is distinguished from other members of this species group by having rather regular polygonal reticulations mediodorsally on the propodosoma, long narrow areolae in the lateral area of the hysterosoma, and the dorsolateral setae rather long and filiform. The male and nymph are unknown.

FEMALE: Body length 237, width 129; markings of dorsum and shapes of dorsal setae as shown in figure 28. Venter with both rounded and elongate areolae between posterior metapodosomals and anterior part of frame of ventral plate; ventral and genital plates with most areolae wider than long.

Holotype: Female, Reynosa, Tam., December 18, 1956, (D. De Leon), on *Cordia boissieri*. *Paratypes*: 6 females, collection data same as for holotype.

Brevipalpus ardesiae, n. sp.
(Figures 29A and 29B)

The female of *Brevipalpus ardesiae* is similar to that of *B. californicus*, differing most noticeably in having somewhat longer dorsolaterals; the nymph is distinct in having all the dorsal setae large. The male is unknown.

FEMALE: Body length 278, width 152; markings of dorsum and shapes of dorsal setae as shown in figure 29A. Venter smooth medially forward of posterior metapodosomals, area between these setae and anterior part of frame of ventral plate with mostly small rounded areolae; ventral plate with small rounded areolae; genital plate with areolae of anterior part somewhat wider than long, those of posterior part much wider than long.

NYMPH: Shapes of dorsal setae as shown in figure 29B.

Holotype: Female, west of Tepic, Nay. (Mirador del Aguila), March

29, 1957, (D. De Leon), on *Ardesia revoluta*. *Paratypes*: 2 females, 2 nymphs, collection data same as for holotype.

Brevipalpus aepi, n. sp.
(Figures 30A and 30B)

Brevipalpus aepi is distinguished by having the propodosoma dorsomedially with large areolae and the mediolateral area with areolae much longer than wide; the nymph is also distinctive. The male is unknown.

FEMALE: Body reddish yellow, length 253-271, width 147. Markings of dorsum and shapes of dorsal setae as shown in figure 30A. Venter smooth medially forward of a line about halfway between anterior and posterior metapodosomals, between this line and anterior part of frame of ventral plate area covered with small more or less round areolae; ventral and genital plates with large areolae much wider than long.

NYMPH: Shapes of dorsal setae as shown in figure 30B.

Holotype: Female, Tuxtla Gutierrez, Ch., January 15, 1957, (D. De Leon), on *Eupatorium hemiteropodum*. *Paratypes*: 1 female, collection data same as for holotype; 3 females, 1 nymph, *Lippia hypoleia*, other data same as for holotype; 2 females, Cordoba, Ver., February 4, 1957, on *Heliocarpus tomentosa*; 4 females, Tepic, Nay., March 25, 1957, on *Verbesina* sp.

Brevipalpus cochlospermi, n. sp.
(Figures 31A and 31B)

Brevipalpus cochlospermi is distinguished from other members of this group by the lack of reticulations on the dorsum of the prodosoma of the female, by the narrow dorsal seta of femur I, and by the sequence of the large dorsolateral setae of the nymph. The male is unknown.

FEMALE: Body length 267-281, width 139-148. Markings of dorsum and shapes of dorsal setae as shown in figure 31A. Venter smooth medially forward of a line about halfway between anterior and posterior metapodosomals, between this line and anterior part of frame of ventral plate areolae rather large and polygonal; ventral plate with areolae indistinct, but rather large and wider than long; genital plate with areolae large and wider than long.

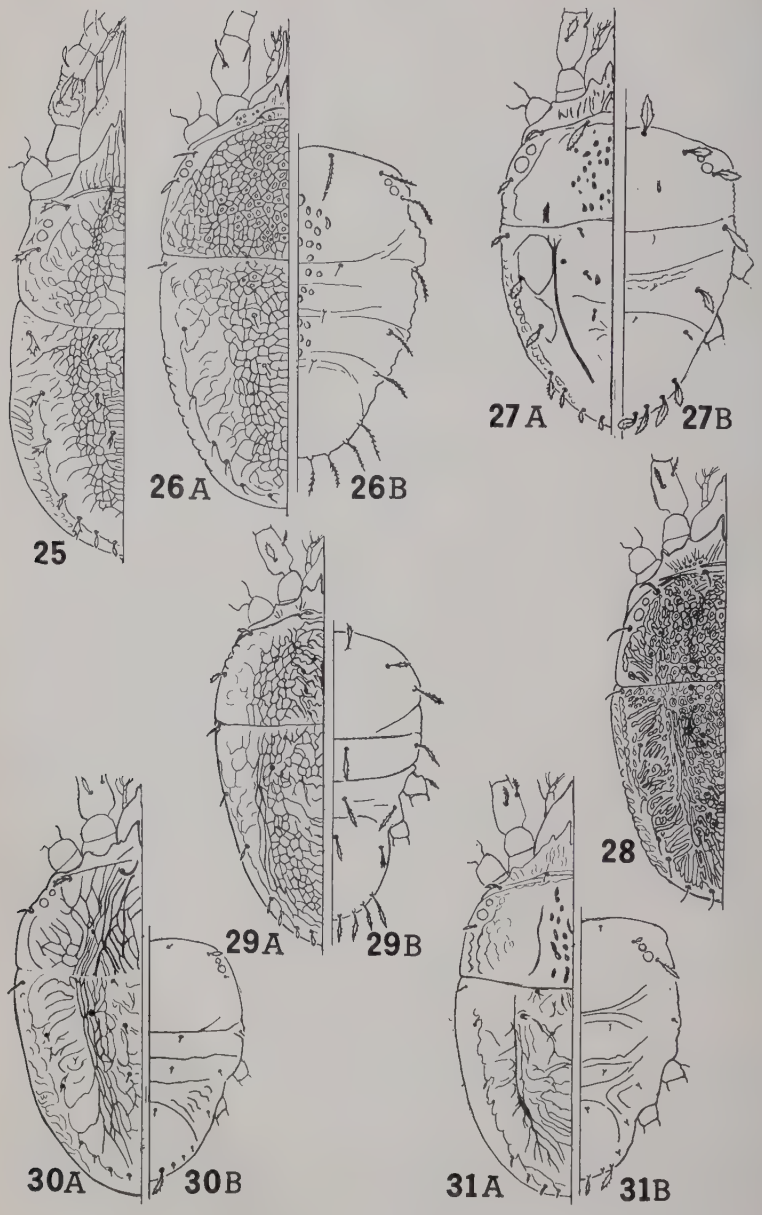
NYMPH: Shapes of dorsal setae as shown in figure 31B.

Holotype: Female, San Blas, Nay., May 21, 1957, (D. De Leon), on *Cochlospermum* sp. *Paratypes*: 8 females, 3 nymphs, collection data same as for holotype.

Brevipalpus gliricidiae, n. sp.
(Figures 32A and 32B)

The female *Brevipalpus gliricidiae* resembles that of *B. cochlospermi*, but is distinguished in the nymphal stage by having the humeral and first dorsolateral setae rather large and oval. The male is unknown.

FEMALE: Body cream to apricot; length 279, width 153. Markings of dorsum and shapes of dorsal setae as shown in figure 32A. Metapodosoma medially with rounded areolae between anterior part of frame of ventral plate and posterior metapodosomals, areolate area in some specimens extending forward almost to anterior pair of metapodosomals. Ventral


25
26A
26B
27A
27B
28
29A
29B
30A
30B
31A
31B

The paired drawings are of the dorsal half of the female, indicated by the letter A and of the dorsal half of the nymph, indicated by the letter B.

Figure 25, Female.	*Brevipalpus proboscidius*, n. sp.
Figures 26A and 26B.	*Brevipalpus rostratus*, n. sp.
Figures 27A and 27B.	*Brevipalpus encinarius*, n. sp.
Figure 28, Female.	*Brevipalpus cordiae*, n. sp.
Figures 29A and 29B.	*Brevipalpus ardesiae*, n. sp.
Figures 30A and 30B.	*Brevipalpus aepi*, n. sp.
Figures 31A and 31B.	*Brevipalpus cochlospermi*, n. sp.
Figures 32A and 32B.	*Brevipalpus gliricidiae*, n. sp.
Figures 33A and 33B.	*Brevipalpus alternatus*, n. sp.
Figures 34A and 34B.	*Brevipalpus combreti*, n. sp.
Figure 35, Female.	*Brevipalpus physali*, n. sp.
Figure 36, Female.	*Brevipalpus pocillator*, n. sp.
Figures 37A and 37B.	*Brevipalpus edax*, n. sp.
Figure 38, Nymph.	*Brevipalpus phoenicis* (Geij.)

plate with areolae rounded to somewhat wider than long; genital plate with areolae much wider than long.

NYMPH: Shapes of dorsal setae as shown in figure 32B.

Holotype: Female, Tuxtla Gutierrez, January 18, 1957, (D. De Leon), on *Gliricidia sepium*. *Paratypes*: 5 females, 1 nymph, collection data as for holotype; 5 females, 1 nymph, Veracruz, January 1, 1957, same host species.

Brevipalpus alternatus, n. sp.

(Figures 33A and 33B)

Brevipalpus alternatus is distinguished by having the dorsum covered with very irregularly shaped areolae, and by the deutonymph having 2 pairs of flagelliform setae. The male is unknown.

FEMALE: Body length 278, width 154. Markings of dorsum and shapes of dorsal setae as shown in figure 33A. Venter smooth medially anterior of ventral plate; ventral plate with indistinct large, regular polygonal areolae; genital plate with narrow areolae wider than long. Tarsal claws with large hooks.

Holotype: Female, San Blas, Nay., March 28, 1957, (D. De Leon), on *Conocarpus erecta*. *Paratypes*: 2 females, 2 nymphs, collection data same as for holotype.

Brevipalpus californicus (Banks)

Brevipalpus californicus, reported by Baker (1949) as having been intercepted on geraniums from Mexico, was collected on many hosts. Some representative collections follow: *Citrus*, Montemorelos, Neuvo Leon; *Ehretia*, *Psychotria*, and *Swietenia*, Tuxtla Gutierrez; *Ficus carica*, Guadalajara; *Casearia* and *Musa sapientum*, San Blas.

Brevipalpus lilium Baker (from *Psychotria*, Tuxtla) was not listed in the previous group because at present I consider it a variant *B. californicus*. The only character separating these 2 species is the presence of 1 or 2 sensory rods on tarsus II of the female; from one plant I have taken *lilium*, *californicus* and specimens with 2 sensory rods on one side and 1 sensory rod on the opposite tarsus. Furthermore the male and the nymph of *lilium* cannot be distinguished from the male and the nymph of *californicus*.

Brevipalpus trinidadensis Baker

Females and nymphs of this species, described from specimens taken on *Lantana*, Trinidad, B. W. I., were common in San Blas on a cultivated shrub-like tree called "agualama" by the inhabitants.

Brevipalpus longisetosus Baker

B. longisetosus was described from specimens collected in Puerto Rico from on unknown host and has not been reported since. Specimens appearing to be this species were collected from mango, Tuxtla Guterriez, and from *Annona*, Veracruz.

The following two species belong to the species group having 6 pairs of dorsolateral hysterosomals, palpus with 1 seta and a sensory rod at distal end, tarsus II of the female with 1 sensory rod, and the posterior metapodosomals very much longer than the anterior pair:

Brevipalpus combreti, n. sp.
(Figures 34A and 34B)

The female of *Brevipalpus combreti* is distinguished from other members of this group by having the mediodorsal and mediolateral areas of the propodosoma evenly covered with small, round areolae; the nymph by having the dorsolaterals large and lanceolate, and the dorsocentrals minute.

FEMALE: Body length 281, width 154; markings of dorsum and shapes of dorsal setae as shown in figure 34A. Venter smooth medially anterior of posterior metapodosomals, between these setae and anterior part of frame of genital plate the surface is more or less transversely striate; genital plate with areolae wider than long. Tarsal claws with large hooks.

MALE: Resembles female, but tarsus II with 2 sensory rods.

NYMPH: Shapes of dorsal setae as shown in figure 34B.

Holotype: Female, Cuitlahuac, Ver., February 5, 1957, (D. De Leon), on *Combretum farinosum*. *Paratypes*: 1 male, 5 nymphs, collection data same as for holotype; 2 females, 1 male, 1 nymph, about 15 miles north of Tehuantepec, Oax., January 31, 1957, on same host species.

Brevipalpus physali, n. sp.
(Figure 35)

Brevipalpus physali resembles *B. selas* Pritchard and Baker (1952), but differs from that species by the rostral shield not being pebbled, by the dorsolateral setae being setiform, and by other characters. The male and nymph are unknown.

FEMALE: Body length 313, width 254; markings of dorsum and shapes of dorsal setae as shown in figure 35. Ventral plate and metapodosoma medially at least as far forward as anterior metapodosomals covered with small, round areolae; genital plate with areolae wider than long. Tarsal claws with large hooks.

Holotype: Female, Veracruz, Ver., December 28, 1956, (D. De Leon), on *Tridax procumbens*. *Paratype*: 1 female on *Physalus* sp., other data as for holotype.

The following 4 species belong to the species group having 5 pairs of dorsolateral hysterosomals, the palpus with 2 setae and a sensory rod at distal end, tarsus II of the female with 1 sensory rod, and the posterior metapodosomals very much longer than the anterior pair:

Brevipalpus pocillator, n. sp.
(Figure 36)

Brevipalpus pocillator is distinguished by having the rostrum reaching practically to the distal end of femur I and the mediodorsal area of the body almost entirely smooth. The male and nymph are unknown.

FEMALE: Body length 277, width 150; markings of dorsum and shapes of dorsal setae as shown in figure 36. Ventral plate and metapodosoma almost fully covered with small, mostly round areolae set about their own diameters apart; genital plate with round and with oval areolae. Tarsal claws without hooks.

Holotype: Female, Jacotepec, Jalisco, March 22, 1957, (D. De Leon), on *Verbesina? Paratypes*: 9 females, Chapala, Jal., on *Ficus?*, other data same as for holotype.

Brevipalpus edax, n. sp.

(Figures 37A and 37B)

Brevipalpus edax is distinguished by having the mediolateral area of the propodosoma with rather regular polygonal areolae, the rostrum reaching nearly to the distal end of femur I and the nymph having rather long, distinctly serrate dorsocentrals. The male is unknown.

Female: Body length 281, width 210; markings of dorsum and shapes of dorsal setae as shown in figure 37A. Venter smooth medially forward of a line somewhat caudal of anterior metapodosomals, posterior of this line areolae wider than long.

Nymph: Shapes of dorsal setae as shown in figure 37B.

Holotype: Female, Tuxtla Gutierrez, Ch., January 10, 1957, (D. De Leon), on *Cordia eleagnoides. Paratypes*: 4 females, 4 nymphs, collection data same as for holotype.

Brevipalpus edwinae Baker

This species, described from Cuernavaca, Morelos, on *Eupatorium* was not collected by the writer.

Brevipalpus obovatus (Donnadieu)

Brevipalpus obovatus is not listed by Pritchard and Baker (1958) as occurring in Mexico. It was collected from a potted palm in Guadalajara, Jal., in March and from a cultivated composite in Puerto Vallarta, Jal., in May, 1957.

The following species is the only one with 5 pairs of dorsolateral hysterosomals and 2 sensory rods on tarsus II of the female:

Brevipalpus phoenicis (Geijskes)

Brevipalpus phoenicis is not listed by Pritchard and Baker (1958) as occurring in Mexico. It was collected from 16 different hosts. Some of the hosts and collection localities follow: *Guazuma*, Valles, S. L. P.; *Terminalia*, and coconut, Veracruz; *Coffea*, Cordoba, Ver.; *Curatella*, Minatitlan, Ver.; *Cordia, Fraxinus*, and *Citrus*, Tuxtla Guiterrez; *Psidium* and *Byrsonima*, Tepic, Nay., and *Anthurium*, San Blas, Nay.

There is considerable variation in the size and shape of the dorsal setae of the nymphs of what appears to be this 1 species; dorsolateral hysterosomals 1 and 2 of the nymphs of most of the Mexican specimens are rather similar in shape to and of about the same size as dorsolateral hysterosomals 3-5 and in 3 collections from Tuxtla and one from Tepic the dorsocentrals are also nearly as large as the dorsolaterals as is shown in figure 38 of a deutonymph taken from *Fraximus* at Tuxtla.

Key to Species (Based on Females Unless Otherwise Stated)

1. Hysterosoma with 6 pairs of dorsolateral setae 2
   Hysterosoma with 5 pairs of dorsolateral setae 42

2(1). Palpus with 2 setae and a sensory rod at distal end....3
Palpus with 1 setae and a sensory rod at distal end....41

3(2). Tarsus II with 1 sensory rod....4
Tarsus II with 2 sensory rods....29

4(3). Rostrum extending beyond distal end of femur I....5
Rostrum not extending beyond distal end of femur I....10

5(4). Dorsal setae long and plumose....*hypti*
Dorsal setae short (less than 25 microns) and smooth or serrate....6

6(5). Body elongate, at least twice as long as wide....*pseudoleptoides*
Body of usual proportions, less than twice as long as wide....7

7(6). Propodosoma medially with many coalesced areolae....*serratus*
Propodosoma medially reticulate, with few or no coalesced areolae..8

8(7). Propodosoma medially with small areolae (8-11 per 30 microns); claws without hooks....*quercicolus*
Propodosoma medially with large areolae (3-6 per 30 microns); claws with hooks....9

9(8). Dorsolateral setae oval, strongly serrate; both setae of palptarsus about equal in length....*lagasceae*
Dorsolateral setae setiform, not or only weakly serrate; one seta of palptarsus much shorter than the other....*crotoni*

10(4). Dorsocentral hysterosomals long and broadly oval....11
Dorsocentral hysterosomals not long and broadly oval....12

11(10). Seta of second segment of palpus setiform, long....*tuberellus*
Seta of second segment of palpus palmate....*formosus*

12(10). Propodosoma medially completely or almost completely reticulate....13
Propodosoma medially not reticulate....22

13(12). Propodosomal seta 1 long (over 25 microns) and elliptic; nymph with some dorsal setae flagelliform....*perseae*
Propodosomal seta 1 setiform, filiform or short and elliptic; nymph without flagelliform dorsal setae....14

14(13). Propodosoma medially with small areolae (7-11 per 30 microns)....15
Propodosoma medially with large areolae (3-6 per 30 microns)....19

15(14). Hysterosoma with a mediolateral groove; dorsolateral hysterosomals not or only weakly serrate....16
Hysterosoma without a mediolateral groove; dorsolateral hysterosomals strongly serrate....18

16(15). Ventral plate practically smooth....*albus*
Ventral plate distinctly areolate....17

17(16). Propodosomal 1 reaching more than halfway to opposite member; nymph with hysterosomals 1 and 2 long and elliptic....*insinuatus*
Propodosomal 1 not reaching halfway to opposite member; nymph with hysterosomals 1 and 2 minute and setiform....*alni*

18(15). Rostral shield areolate about to anterior edge; hysterosoma without coalesced areolae medially; nymph with dorsocentral 3 long and serrate....*chucumayi*

Rostral shield areolate at base only; hysterosoma with coalesced areolae medially; nymph with dorsocentral 3 short and smooth ..... *oreopanacis*

19(14). Hysterosoma evenly reticulate medially or with only a few coalesced areolae 20
Hysterosoma with numerous transversely coalesced areolae medially 21

20(19). Venter of propodosoma almost fully covered with areolae; nymph with most dorsolateral hysterosomals rather long and strongly serrate ..... *ewpristori*
Venter of propodosoma with scattered transverse striae medially; nymph with dorsolateral hysterosomals minute or short and weakly serrate ..... *essigi* Baker

21(19). Ventral plate practically smooth ..... *oaxacensis*
Ventral plate distinctly areolate ..... *filifer*

22(12). Hysterosoma with a mediolateral groove and usually with elongate areolae in mediolateral area 23
Hysterosoma without a mediolateral groove and with rather regular polygonal or rounded areolae in mediolateral area 27

23(22). Propodosoma in mediolateral area with numerous longitudinal striae ..... *striatus*
Propodosoma in mediolateral area nearly smooth or with elongate areolae 24

24(23). Hysterosoma medially smooth or with a few transverse depressions ..... *levis*
Hysterosoma medially with convoluted areolae 25

25(24). Dorsal propodosomal 1 reaching much less than halfway to base of opposite member ..... *mori*
Dorsal propodosomal 1 reaching more than halfway to base of opposite member 26

26(25). Anterior dorsolaterals slender; area bordering inner edge of posterior apodeme of coxa II with a few striae; tarsal claws with strong hooks ..... *variolatus*
Anterior dorsolaterals narrow elliptic; area bordering inner edge of posterior apodeme of coxa II with small round areolae; tarsal claws with rather small, indistinct hooks ..... *rugosus*

27(22). Propodosoma and hysterosoma bordered by a slight crest or ridge near lateral margin ..... *testudinalis*
Propodosoma and hysterosoma without a crest or ridge laterad 28

28(27). Ventral plate and area anterior of it with small rounded areolae; nymph with all dorsolaterals elliptic and rather large ..... *religiosae*
Ventral plate and area anterior of it with areolae wider than long; nymph with some dorsolaterals minute ..... *russulus* (Boisduval)

29(3). Rostrum extending beyond distal end of femur I 30
Rostrum not extending beyond distal end of femur I 31

30(29). Rostrum extending about to distal end of tibia I ..... *proboscidius*
Rostrum not reaching distal end of genu I ..... *rostratus*

31(29). Propodosomal 1 elliptic, over 18 microns long ..... *encinarius*
Propodosomal 1 setiform or elliptic, less than 15 microns long 32

32(31). Propodosoma medially with regular polygonal reticulations.....33
Propodosoma medially without regular polygonal reticulations.....35

33(32). Mediolateral area of dorsum of hysterosoma with areolae much longer than wide.....*cordiae*
Mediolateral area of dorsum of hysterosoma with rather regular reticulations or areolae not much longer than wide.....34

34(33). Nymph with dorsolateral hysterosomals 3-6 narrow elliptic and of about the same lengths.....*californicus* (Banks)
Nymph with dorsolateral hysterosomals 3 and 5 minute and setiform.....*trinadadensis* Baker

35(32). Mediolateral area of propodosoma with rather regular polygonal reticulations.....36
Mediolateral area of propodosoma not as above.....37

36(35). Deutonymph with dorsocentrals short and setiform.....*californicus* (Banks)
Deutonymph with dorsocentrals long (over 20 microns) and elliptic.....*ardesiae*

37(35). Propodosoma medially with large, irregularly shaped areolae....*aepi*
Propodosoma medially smooth or with scattered pits or depressions and/or narrow longitudinal areolae.....38

38(37). Mediodorsal seta of femur I very narrow elliptic (almost setiform in some specimens); nymph with dorsolateral propodosomals 2 and 3 and hysterosomals 4 and 6 elliptic, the others setiform and minute.....*cochlospermi*
Mediodorsal setae of femur I elliptic; nymph with some dorsal setae flagelliform or with at least 6 pairs of elliptic dorsolaterals.....39

39(38). Nymph without flagelliform dorsal setae.....*gliricidiae*
Nymph with some dorsal setae flagelliform.....40

40(39). Deutonymph with 3 pairs of flagelliform dorsal setae.....*longisetosus* Baker
Deutonymph with 2 pairs of flagelliform dorsal setae.....*alternatus*

41(2). Hysterosoma with a distinct mediolateral groove.....*combreti*
Hysterosoma without a mediolateral groove.....*physali*

42(1). Tarsus II with 2 sensory rods.....*phoenicis* (Geij.)
Tarsus II with 1 sensory rod.....43

43(42). Hysterosoma smooth medially.....44
Hysterosoma medially with irregularly shaped areolae.....45

44(43). Rostrum reaching nearly to end of femur I.....*pocillator*
Rostrum reaching about to middle of femur I.....*edwinae* Baker

45(43). Dorsolaterals elongate; nymph with dorsocentrals short and strongly serrate.....*edax*
Dorsolaterals short; nymph with dorsocentrals minute and smooth.....*obovatus* (Donnadieu)

The types of the new species are in the author's collection; paratypes will be deposited in the University of Florida Collections, Gainesville.

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KALOTERMES APPROXIMATUS SNYDER INFESTS ROSEACEOUS TREES (ISOPTERA: KALOTERMITIDAE)

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On April 10, 1960, I was awakened by the sounds of a falling tree. This tree was a wild or black cherry, *Prunus serotina* Ehrh., approximately 50 feet tall and 11 inches D.B.H. The top of the tree was heavy with new foliage and maturing green fruit. The air was still at the time of breakage and wind was not a contributing factor. The point of breakage was 14 feet above ground level.

Since this tree was in my own back yard, observations were made both before and after breakage. On its relatively clean trunk, I had noted that a slight fusiform swelling started about 11 feet above ground and extended about 6 feet up from this point. The degree of swelling was an increase of about 1 inch, or from 11 inches to 12 inches diam., at the 14 foot level where break occurred. Several years before breakage, it was noted that numerous adventitious buds were being produced on the trunk below this slight swelling. The reason for such buds was not apparent at the time they were first observed.

In clearing the fallen portion of this tree, it was readily apparent that the break had been caused by the presence of a colony of the drywood termite, *Kalotermes approximatus* Snyder. At the point of breakage, the heartwood cylinder had been approximately 10 inches in diameter. This left a ring of sapwood about 1 inch in thickness. Since the supporting heartwood cylinder had been completely eaten away by the termites, the ring of sapwood was providing support (both mechanically and vegetatively) for the crown of the tree. As the weight of the branches, foliage, and fruit increased with the spring season, the trunk broke like a soda straw.

The feeding of the colony of termites in the heartwood extended 3 feet above the breakage point. I estimated that feeding also extended 3 feet below this point in the 14 foot "stump". The stump, with its termites and adventitious branches, is being retained for future observations.

The colony of *K. approximatus* had obviously been established and active in this tree for some years. Entrance was gained through a branch scar, and repeated infestation of the callus tissues by larvae of an aegeriid moth, probably *Synanthedon pictipes* (B. & R.)[1] had prevented the closure of this wound. Since nymphs of the reproductive caste function as "workers" among the drywood termites, 2 years are required for development from eggs to winged, reproductive adults. It must take a considerable length of time for a colony of these termites to develop to such extensive proportions as encountered in the wild cherry tree. Winged reproductives of *K. approximatus* are most frequently encountered during the autumn months and have been observed in flight during daylight hours. Of course, winged adults were not present in the colony in April, 1960; identification was made from the soldier caste.

[1] Determined by H. W. Capps, U. S. National Museum.

It is customary to associate pellets of excrement with drywood termite infestations and such pellets are present in building infestations where there is little moisture in the wood. However, when plenty of moisture is available the drywood termites do not hesitate to use it. This then results in semifluid excrement rather than pellets. A parallel situation may be readily observed among the fairly closely related roaches; with plenty of available water, excrement is fluid or semifluid; with a shortage of water, pellets of excrement result because of the need to conserve the available moisture. In the case of the living wild cherry tree, abundant moisture was available from rainwater entering the branch scar as well as the high content of moisture in the heartwood of the living tree. Large masses of carton-like excrement were present in the cavity of the wild cherry tree and spots of excrement were common on uneaten portions of the wood; there were very few pellets.

Kalotermes approximatus was described by Snyder 40 years ago (Banks & Snyder, 1920) from soldiers collected from stumps of sweet gum, *Liquidambar styraciflua* L., at Ortega, Florida (near Jacksonville). Snyder later (1924 and 1925) described finding additional soldiers and winged adults in dead cypress near Cape Henry, Virginia. The species is recorded from northern Florida, southern Louisiana, southern Mississippi, and Bermuda (Snyder, 1949). Dr. Snyder has indicated in correspondence that a "very few" cases of building infestation by *K. approximatus* have been reported from southern Louisiana and southern Mississippi. I have also observed infestations of this species in the heartwood of living, but decadent, pear trees, *Pyrus communis* L., in several areas of northern Florida. Miller (1949) states that this termite has been found "in dead, dry wood of oak, sweet gum, and magnolia trees in northern and central Florida." Mr. I. W. Hughes (personal communication), Bermuda Department of Agriculture, has stated that this termite has increased in recent years in Bermuda in standing trees of Bermuda juniper killed by scale insects.

Summary

Observations on this little-known, drywood termite in northern Florida have shown colonies to be established in the heartwood of living pear and wild cherry trees. Recent mid-trunk breakage of a large wild cherry tree was caused by extensive feeding of a colony of these termites.

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